

**A CATALOGUE OF CRUDE OIL AND OIL PRODUCT PROPERTIES
(1989 Version)**

by

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ABSTRACT

This catalogue provides data on various physical-chemical properties of crude oils and petroleum products. The properties that are reported are those which will likely determine the environmental behaviour and effects of spilled oil. The oils are arranged in alphabetical order.

RESUME

Ce catalogue fournit des données sur diverses propriétés physico-chimiques des huiles brutes et des produits pétroliers. Les propriétés énumérées détermineront probablement le comportement environnemental et les effets des hydrocarbures déversés. La liste des huiles et des produits pétroliers est présentée par ordre alphabétique.

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FOREWORD

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1.0 INTRODUCTION

This catalogue is a compilation of available data on crude oils and petroleum products. The emphasis of the catalogue is upon oils which could potentially impact Canada's environment. Other oils which are unlikely to be of direct Canadian concern are also included because they have been well characterized and used in relevant studies. The properties listed for each oil are those which will provide an indication of a spilled oil's environmental behaviour and effects.

Most of the chemical-physical properties listed in this catalogue were measured using standard tests, such as ASTM test methods. Certain properties which are reported do not have standard test methods; examples of such properties are aqueous solubility and toxicity. The reader who wishes to make use of such data should refer directly to the original source to obtain specific details on the techniques and parameters used. Since data from many sources are cited, differences in reported values may be due to the variance of samples and inherent differences in measurement techniques.

The oils are arranged in alphabetical order. The names used to identify the oils in this catalogue are those used by the authors of the original data or by the suppliers of the samples. The reader should be aware of the following points when searching for information on a specific oil. Crude oils from the same region are often given the same name even though oils from different wells can have markedly different properties. Similarly, crude oils that are transported are often mixtures of crudes from different wells. Even the properties of oil taken from an individual well can vary with the depth of the well and the year of production. Also, there may be the possibility that different authors refer to the same crude oil by different names. The refined products are indexed according to their most commonly used names and any synonyms are cross referenced in the Table of Contents.

For certain properties, data are given at different temperatures and for different degrees of oil weathering. An oil's degree of weathering is expressed as the volume or weight percent evaporated from the fresh oil. Weathered oils used for testing by the Environmental Emergencies Technology Division (EETD) were artificially weathered by gas stripping following the method of Mackay and Stiver (Mackay 1982a, Mackay 1983b). Equations are reported to describe the effects of temperature and weathering on some properties. Note that these equations are applicable only to the temperature and weathering range of the original data.

Where data were not available for some properties, blank spaces were allocated in their places in order to facilitate future updating. The following abbreviations are used in the data sections: N/A (not applicable); N/M (not measurable); MAX (maximum); MIN (minimum); ND (not detected); and MW (molecular weight).

2.0 DESCRIPTION OF DATA

2.1 Type

The type of crude or oil product is specified and any other relevant information is provided in this section.

2.2 API Gravity

API gravity is defined as:

$$\text{API Gravity} = \frac{141.5}{\text{Sp. Gr. (60/60°F)} - 131.5}$$

where Sp. Gr. (60/60°F) is the oil density at 60°F (15.6°C) divided by the density of water at 60°F.
(ASTM D 287, ASTM D 1298)

2.3 Density

Density is defined as the mass of a unit volume of oil at a specified temperature and has the units g/mL. (Speight 1980, ASTM D 941, ASTM D 1217, ASTM D 1298, ASTM D 4052)

The density of crude oils and oil products is dependent on temperature and degree of weathering. A convenient equation to express density at different temperatures and degrees of weathering (Mackay 1983a) is:

$$p = p_0 + C_1F - C_2(T - T_s)$$

where: p is density at T and F (g/mL)
 p_0 is density of fresh oil at T_s (g/mL)
 C_1, C_2 are constants
 F is fraction of oil weathered
 T is temperature of oil (°C)
 T_s is standard temperature (°C)

The results reported from EETD were measured using an Anton Paar densiometer and following ASTM method D 4052.

2.4 Viscosity

Viscosity is a measure of a fluid's resistance to flow. It is defined as:

$$\text{Dynamic Viscosity} = \frac{\text{Shear Stress}}{\text{Rate of Shear}}$$

The units for dynamic viscosity are millipascal seconds (Pa.s) or centipoise (cP). (ASTM D 2532, ASTM D 2983)

Kinematic viscosity is defined as:

$$\text{Kinematic Viscosity} = \frac{\text{Dynamic Viscosity}}{\text{Density}}$$

The unit for kinematic viscosity is mm²/s or centistoke (cSt). (ASTM D 445)

Viscosity is dependent upon temperature and the degree of weathering (Mackay 1983a) as follows:

$$u = u_0 \exp(C_3 F) \exp(C_4 (1/T_k - 1/T_{ks}))$$

where: u is viscosity at F and T_k (mPa.s)
 u_0 is viscosity of fresh oil at T_{ks} (mPa.s)
 C_3, C_4 are constants
 F is fraction of oil weathered
 T_k is temperature of oil
 (Kelvin, $T_k = ^\circ\text{C} + 273$)
 T_{ks} is standard temperature (Kelvin)

The dynamic viscosity results reported from EETD were measured using a Brookfield LVT viscometer. For non-Newtonian oils the viscosity measurements were carried out at as low a shear rate as possible. The kinematic viscosity results reported from EETD were measured using Zeitfuchs cross-arm capillary viscometers and following ASTM method D 445.

2.5 Interfacial Tensions

Interfacial tension is the force of attraction between the molecules at the interface of a liquid (Fingas 1979). An indication of both the oil-air and oil-water interfacial tension is essential for calculating spreading rates and the likely extent to which the oil will form oil-in-water and water-in-oil emulsions (Mackay 1983a).

Interfacial tensions are commonly measured by the de Nouy ring technique in which the force required to draw a platinum-iridium ring through the interface is measured (Mackay 1983a, ASTM D 971, ASTM D 2285). The units for interfacial tension are mN/m (or dynes/cm). The results reported from EETD were obtained using a Fisher Surface Tensiometer Model 21 and following ASTM method D 2285.

The effect of weathering on interfacial tensions (Mackay 1983a) is shown below:

$$S_{OA} = S_{OA0} + C_5 F$$

where: S_{OA} is oil-air interfacial tension (mN/m) at F
 S_{OA0} is oil-air interfacial tension of
 fresh oil (mN/m)
 C_5 is a constant
 F is fraction of oil weathered

$$S_{OW} = S_{OW0} + C_6 F$$

where: S_{OW} is oil-water interfacial tension at F
 (mN/m)
 S_{OW0} is oil-water interfacial tension of
 fresh oil (mN/m)
 C_6 is a constant

2.6 Pour Point

Pour point is the lowest temperature, expressed as a multiple of 3 °C, at which the oil sample is observed to flow when cooled under prescribed conditions (ASTM D 97). After preliminary heating, the oil sample in a test jar is cooled at a specified rate by immersion into cooling baths kept at different temperatures. The lowest temperature at which movement of oil is observed in the test jar is recorded as the pour point (in °C).

Pour point as affected by weathering (Mackay 1983a) can be expressed as follows:

$$PP = PP_0 (1 + C_7 F)$$

where: PP is pour point (°C)

PP₀ is pour point of fresh oil (°C)

C₇ is a constant

F is fraction of oil weathered

2.7 Flash Point

Flash point is the lowest temperature, corrected to one atmosphere (101.3 kPa), at which vapours above an oil sample ignite in air when exposed to a flame under specified test conditions. Flash point can be measured by Cleveland Open-cup, Tag Closed and Open-cup, Pensky-Martens Closed, and Setaflash Closed Testers. Generally, the oil sample in the open cup type testers is heated in a open vessel to a selected temperature. A test flame is introduced over the surface of the oil to determine whether the flash point has been reached. If not, the temperature of the oil sample is raised at a specified rate and the process repeated. In closed cup testers, the oil sample is enclosed until a test flame is applied at a specified temperature. If flash point is not reached, the oil sample is covered, the oil temperature is increased at a specified rate and the process is repeated. Loss of volatiles from the oil samples is reduced in this procedure (TSB 1984, ASTM D 92, ASTM D 56, ASTM D 1310, ASTM D 93, ASTM D 3278, Lance 1979).

In the data section, flash points determined by open cup and closed cup type testers are designated by "(O.C.)" and "(C.C.)", respectively. No designation is provided if the testing method is not known.

The effect of weathering on flash point (Mackay 1983a) is:

$$L = L_0 (1 + C_8 F) \quad (2.9)$$

where: L is flash point at F ($^{\circ}\text{C}$)
 L_0 is flash point of fresh oil ($^{\circ}\text{C}$)
 C_8 is a constant
 F is fraction of oil weathered

The results reported from EETD were obtained using a Pensky-Martens closed tester and following ASTM method D 93.

2.8 Vapour Pressure

Vapour pressure is the pressure that an oil exerts on its surroundings. Its units are kPa corrected to one atmosphere (101.3 kPa). Vapour pressure can be measured by Reid, dynamic, static, isoteniscopic, vapour pressure balance and gas saturation methods. The most commonly used method for crude oils has been the Reid vapour pressure which measures vapour pressure at 37.8 °C (100 °F). It is measured by saturating a known volume of oil in an air chamber of known volume and measuring the equilibrium pressure which is then corrected to one atmosphere (101.3 kPa) (ASTM D 323, ASTM D 2551, ASTM D 2879, OECO 1981, TSB 1984, USEPA 1982).

The results reported from EETD are Reid vapour pressure determinations (ASTM D 323).

2.9 Distillation Data

Distillation data provides an indication of an oil's volatility and relative component distribution. Numerous techniques are available for determining the distillation curve. (ASTM D 86, ASTM D 216, ASTM D 285, ASTM D 1160, ASTM D 2892)

Unless otherwise stated, the data reported in the catalogue are presented as volume percent recovered versus the measured vapour temperature. The results reported from EETD were obtained using the distillation method described by Mackay and Stiver (Mackay 1984) where both the oil's liquid and vapour temperatures are recorded.

The following definitions are useful:

- Initial boiling point (IBP) is the temperature at the instant that the first drop of condensate falls from the lower end of the condenser tube.
- End point or final boiling point (FBP) is the maximum temperature obtained during the test. This usually occurs after the evaporation of all liquid from the bottom of the flask.
- Percent recovered is the volume in millilitres of condensate observed in the receiving graduated cylinder, in connection with a simultaneous thermometer reading.

2.10 Emulsion Formation Tendency and Stability

A water-in-oil emulsion (colloquially named "chocolate mousse") is a stable emulsification of small droplets of water incorporated in oil. Oil spilled on a water surface may form stable water-in-oil emulsions which can have very different characteristics than the parent crude oil.

The tendency for a crude oil to form a stable water-in-oil emulsion is measured (Mackay 1982a, Mackay 1984a) as follows:

- Rotate oil and artificial seawater (oil-to-water volume ratio of 1 to 9) in a stoppered Fleaker for one hour at 65 rpm followed by a half hour resting period.
- Measure, visually, fraction of oil that is in the emulsion (f).
- Repeat rotation, resting and measurements three times.
- Obtain f_{initial} by extrapolation.

The following criteria were used to classify the tendency of a crude oil to form stable emulsion (Mackay 1982a):

Range of f_{initial}	Emulsion Formation Tendency
0.0 to 0.25	Not likely
0.25 to 0.75	Fairly likely
0.75 to 1.0	Very likely

The stability of a water-in-oil emulsion is obtained by allowing the emulsion to rest for 24 hours in the stoppered Fleaker in an upright position, and measuring the fraction of oil in the emulsion (f_{final}) visually. The stability of the water-in-oil emulsion is classified (Mackay 1982a) as follows:

Range of f_{final}	Emulsion Stability
0.0 to 0.25	Unstable
0.25 to 0.75	Fairly stable
0.75 to 1.0	Very stable

The calculated water content of stable water-in-oil emulsions is also provided.

2.11 Weathering

Weathering of crude oils in the environment can be estimated from the modified distillation curve described by Stiver and Mackay (Stiver 84). The oil's liquid temperature is monitored instead of the temperature of the saturated vapour as in standard distillation methods. From the gradient and the initial boiling temperature of the distillation curve (a plot of oil temperature versus fraction of oil condensed), the fraction of oil weathered under environmental conditions can be estimated. This estimation method is not very accurate for prolonged weathering of oil spills. At low environmental temperatures, some oils have a tendency to form a surface layer that may reduce the evaporation rate. This estimation method does not apply to refined petroleum products (Mackay 1982a, Mackay 1983b).

The calculation procedure is as follows:

(1) Obtain or estimate the following:

- average environment temperature (T_k) in Kelvin
(Kelvin = $^{\circ}\text{C} + 273$)
- volume of the oil spill (V) in m^3 ,
- area of the oil spill (A) in m^2 ,
- duration of oil spill (t) in seconds
- average wind speed in m/s ,

(2) Calculate mass transfer coefficient (K) in m/s :

$$K = 0.002 (\text{wind speed})^{0.78}$$

(3) Calculate evaporative exposure (θ):

$$\theta = K A t / V$$

θ can also be calculated if the thickness (in m) of the oil slick can be estimated:

$$\theta = K t / \text{thickness}$$

(4) Calculate fraction (by volume) of oil weathered:

$$F_v = \frac{\ln(1 + 10.3 T_G \theta \exp(6.3 - 10.3 T_O/T_K) / T_K)}{(10.3 T_G / T_K)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log (or take log base 10 and multiply by 2.3)
 T_O is initial boiling point of modified distillation curve (Kelvin)
 T_G is gradient of modified distillation curve (Kelvin)
 $\exp$ is exponential base e

2.12 Dispersibility

Chemical dispersibility provides a relative indication of how effective a dispersant might be in dispersing oil spilled at sea. Similarly, natural dispersibility provides an indication of an oil's tendency to naturally disperse. The Mackay-Nadeau-Steelman (MNS) apparatus described by Mackay and Szeto (Mackay 1980b) was used to test dispersibility. This test consists of a 30 cm diameter vessel containing 6 liters of sea water, onto which 10 mL of oil is placed, followed by a volume of dispersant if chemical dispersibility is being tested. A tangentially introduced air stream produces a circular wave motion of the surface water. A water sample is taken from a fixed location in the vessel after a mixing period of 10 minutes and is analysed for oil content. The percentage of oil dispersed into the water column is calculated and is expressed as a weight percent of the initial volume of oil spilled.

In this report, dispersibility tests were performed using production grade Corexit 9527 which was applied to the oil surface in a dropwise manner and at an oil-to-dispersant ratio of 20:1. All results are reported as an average value of at least 2 replicates. Results that are listed as not measureable (N/M) occurred when the physical nature of the test oil caused unacceptable wave dampening in the apparatus.

2.13 Hydrocarbon Group Analysis

The major hydrocarbon groups in oil are:

- Saturates: saturated alkanes with structures of C_nH_{n+2} or C_nH_{2n} . Also called paraffins.
- Aromatics: compounds that have a benzoid ring as part of their chemical structure. They are considered to be the most toxic hydrocarbons found in oils (Fingas 1979).
- Polars: polar compounds are generally rich in oxygen and other heteroatoms.
- Asphaltenes: polynuclear aromatic clusters with relatively small alkane side chains. They are insoluble in alkane solvents such as heptane and hexane (Mackay 1984a).
- Olefins: unsaturated straight chain hydrocarbons. Also called alkenes.

Saturates, aromatics and polars contents can be determined using various techniques such as open column chromatography or HPLC (ASTM D 936, ASTM D 1319, ASTM D 2007, ASTM D 2549). Asphaltene content is obtained by precipitation and filtration using hexane (Mackay 1982a). The results reported from EETD were obtained by using a HPLC separation method developed by Waters Associates.

Asphaltene content increases with increasing weathering (Mackay 1983a) as follows:

$$ASPH = ASPH_0 / (1 - F)$$

where: ASPH is asphaltene content at F (mass fraction)

$ASPH_0$ is asphaltene content of fresh oil (mass fraction)

2.14 Aqueous Solubility

Aqueous solubility is a useful indicator of an oil's likely toxicity to aquatic biota. The solubility of oil in water can be determined by bringing to equilibrium a volume of oil and water, and then analyzing the water phase. Since oil is a complex mixture of components and each component has a different solubility in water, an oil's aqueous solubility is expressed as the cumulative concentration of the individually dissolved components. The composition and concentration of the solubilized mixture will depend upon conditions used during equilibration. The term "solubility" as applied to oils is being replaced by the technically more precise term "water soluble fraction". The values reported in this catalogue were taken from those studies where an excess of oil was used (oil-to-water volume ratios of at least 1:20) and where the processes of evaporation and oil-in-water emulsification were prevented.

Solubility is significantly reduced by weathering (Mackay 1983a) as follows:

$$S = S_0 \exp (-C_{10}F)$$

where: S is solubility at F (mg/L)
 S_0 is solubility of fresh oil (mg/L)
 C_{10} is a constant
 F is fraction of oil weathered

2.15 Toxicity

Toxicity values are given as:

- LC_{50} : Median lethal concentration is the estimated concentration of material which will cause death to 50 percent of the test population in a specified time after exposure. In most instances, LC_{50} is statistically derived by analysis of mortalities in various test concentrations after a fixed period of exposure.

- EC_{50} : Median effective concentration is used when an effect other than death is the observed endpoint. EC_{50} is the estimated concentration of material in water which will have a specific effect on 50 percent of the test population in a specified time after exposure. EC_{50} values cited from Maclean and Bobra (Maclean 1988, Bobra 1988) are the calculated concentrations that caused 50 percent of the test organisms to stop swimming (this included immobile and dead organisms).

2.16 Sulphur

The total sulphur content of oil can be determined by numerous standard techniques (ASTM D 129, ASTM D 1226, ASTM D 1552, ASTM D 2622, ASTM D 4294). The sulphur content results from EETD were obtained by using non-dispersive X-ray fluorescence spectrometry (ASTM D 1266).

2.17 Other Data

Colour

The observed colour of the oil is provided.
(ASTM D 156, ASTM D 1500, ASTM D 2392)

Fire Point

Fire point is the lowest temperature, corrected to atmospheric pressure (101.3 kPa), that the application of a test flame to the oil sample surface causes the vapour of the oil to ignite and burn for at least five seconds. It is measured by Cleveland Open Cup and modified Pensky-Martens Apparatus. The procedure is similar to the procedure for flash point determination (ASTM D 92, IP 35).

The effect on fire point due to weathering (Mackay 1983a) is:

$$I = I_0 (1 + C_9 F)$$

where: I is fire point at F ($^{\circ}\text{C}$)
 I_0 is fire point of fresh oil ($^{\circ}\text{C}$)
 C_9 is a constant
 F is fraction of oil weathered

Wax

Waxes generally consist of long-chain hydrocarbons and probably consist of straight or branched chain paraffins (Nelson 1958, Fingas 1979). The wax content can be determined by adding methyl ethyl ketone to the oil sample and chilling the mixture to -10°C . Waxes are precipitated and collected by filtration (Mackay 1983a).

Wax content increases with increasing weathering (Mackay 1983a) as follows:

$$\text{WAX} = \text{WAX}_0 / (1 - F)$$

where: WAX is wax content at F (mass fraction)

WAX₀ is wax content of fresh oil (mass fraction)

F is fraction of oil weathered

Carbon Residue

Carbon residue is the carbonaceous residue formed after evaporation and pyrolysis of a petroleum product. Carbon residue can be determined by the Conradson or the Ramsbottom methods. The Conradson carbon residue method is more applicable to crude oils and heavy fuel oils. It involves destructive distillation of a weighed oil sample in a crucible. The oil sample is further heated severely for a fixed period of time while the distillation residue undergoes cracking and coking. The Conradson carbon residue is the weight percent of the carbonaceous residue left in the crucible (ASTM D 189, ASTM D 524).

Hydrogen Sulphide

Hydrogen sulphide content for natural gas and liquefied petroleum gases can be determined by cadmium sulphate-iodometric titration and lead acetate methods, respectively (ASTM D 2385, ASTM D 2420).

Metals

The content of many metals in petroleum can be determined by atomic absorption (ASTM D 2788, Skoog 1976).

Spreading

The spreading coefficient is an indication of the tendency for crude oils and oil products to spread. The spreading coefficient is defined as:

$$\text{Spreading Coefficient} = S_{WA} - S_{OA} - S_{OW}$$

where: S_{WA} is water-air interfacial tension (mN/m)
 S_{OA} is oil-air interfacial tension (mN/m)
 S_{OW} is oil-water interfacial tension (mN/m)

Spreading to a thin slick will occur if the spreading coefficient of an oil is greater than zero, and the higher the spreading coefficient the faster the spreading will occur (Twardus 80).

Yield on Crude

Yield on crude is a routinely performed distillation procedure within the petroleum industry and is part of the procedure of analysis known as the U.S. Bureau of Mines Routine Method for the Analysis of Crude Petroleum. The distillation provides information on the yield of specific fractions obtained from a crude oil (Coleman 1978).

Compositional Analysis

Detailed compositional analysis of petroleum can be obtained through gas chromatography or gas chromatography/mass spectrometry.

1.0 TYPE: ADGO CRUDE OIL.

2.0 API GRAVITY (15/15°C): 16.8(EETD 84)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING			
	0	2.6(vol%)	5.4(vol%)	4(%) 12(%)
0	0.959 (EETD 84)	0.962 (EETD 84)	0.9672 (EETD 85)	
15	0.953 (EETD 84)	0.960 (EETD 84)	0.9572 (EETD 85)	
20	0.9520 (ESSO 83)		0.9526 (ESSO 83)	0.9546 (ESSO 83)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)	
	0	2.6
0	165.0(EETD 84)	220(EETD 85)
15	61.6(EETD 84)	73(EETD 85)

4.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (°C)	WEATHERING			
	0	2.6(vol %)	4(%)	12(%)
-10	661.3 (ESSO 83)		724.5 (ESSO 83)	1302 (ESSO 83)
0	172.1 (ESSO 83) 233.9 (ESSO 83)	228.7 (EETD 85)	263.6 (ESSO 83)	413.8 (ESSO 83)
15	64.6 (ESSO 83) 73.01 (ESSO 83)	76.0 (EETD 85)	79.08 (ESSO 83)	103.2 (ESSO 83)
25	39.83 (ESSO 83)		42.72 (ESSO 83)	53.58 (ESSO 83)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)	
	0	2.6
0	33.3 (EETD 84)	31.5 (EETD 84)
15	32.0 (EETD 84)	30.6 (EETD 84)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)	
	0	2.6
0	16.8 (EETD 85)	16.8 (EETD 85)
15	6.9 (EETD 84)	21.5 (EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)	
	0	2.6
0	25.9 (EETD 85)	22.6 (EETD 85)
15	24.9 (EETD 84)	22.2 (EETD 85)

6.0 POUR POINT:

WEATHERING (%)	POUR POINT (°C)
0	-26 (ESSO 83)
4	-26 (ESSO 83)
12	-26 (ESSO 83)

7.0 FLASH POINT:

WEATHERING (%)	FLASH POINT (°C)
0	95 (ESSO 83)
4	94 (ESSO 83)
12	126 (ESSO 83)

8.0 REID VAPOUR PRESSURE (kPa): N/M (EETD 84)

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	WEATHERING (%)		
	0	4	12
INITIAL	159 (ESSO 83)	170 (ESSO 83)	205 (ESSO 83)
50	329 (ESSO 83)	326 (ESSO 83)	348 (ESSO 83)
FINAL	535 (ESSO 83)	542 (ESSO 83)	538 (ESSO 83)
FINAL VOL CONT'D.	93 % (ESSO 83)	96 % (ESSO 83)	87 % (ESSO 83)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (VOL %)		
	0	2.6	5.4
0	0.61(EETD 84)	0.72(EETD 84)	
15	0(EETD 85)	1.0(EETD 85)	0(EETD 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (VOL %)		
	0	2.6	5.4
0	0.95(EETD 84)	0.96(EETD 84)	
15	0(EETD 85)	1.0(EETD 85)	0.79(EETD 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	2.6	5.4
0	71.5(EETD 84)	73.8(EETD 84)	
15	N/A(EETD 85)	77.1(EETD 85)	78.2(EETD 85)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 2012.6 \theta \exp(6.3 - 5675.3/TK)/TK)}{(2012.6/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$) (EETD 84)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING	
	(VOL %)	
	0	2.6
0	92 (EETD 85)	88 (EETD 85)
15	88 (EETD 85)	71 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING	
	(VOL %)	
	0	2.6
0	62 (EETD 85)	<1 (EETD 85)
15	23 (EETD 85)	10 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	79.8
AROMATICS	18.8
POLARS	0.9
ASPHALTENES	0.5 (EETD 86)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

WEATHERING (VOL %)	SULPHUR CONTENT (WT %)
0	0.19 (EETD 86)
5.4	0.21 (EETD 86)

17.0 OTHERS:

17.1 FIRE POINT ($^{\circ}\text{C}$):WEATHERING
(%)FIRE POINT
($^{\circ}\text{C}$)

0	116 (ESSO 83)
4	123 (ESSO 83)
12	129 (ESSO 83)

- 1.0 TYPE: ALASKA NORTH SLOPE CRUDE OIL (ANS, SUDLEROCHIT).
- 2.0 API GRAVITY: 26.4 (AALUND 83)
- 3.0 DENSITY (g/mL):
 @ 21 °C: 0.8954 (AALUND 83)
- 4.0 VISCOSITY:
 - 4.1 DYNAMIC VISCOSITY:
 - 4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
 @ 15.6 °C: 42.42 (AALUND 83)
- 5.0 INTERFACIAL TENSIONS:
- 6.0 POUR POINT (°C): -17.8 (AALUND 83)
- 7.0 FLASH POINT:
- 8.0 REID VAPOUR PRESSURE (kPa): 24.495 (AALUND 83)
- 9.0 DISTILLATION DATA:
- 10.0 EMULSION FORMATION & TENDENCY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:
- 13.0 HYDROCARBON GROUP ANALYSIS:
- 14.0 AQUEOUS SOLUBILITY:
- 15.0 TOXICITY:
- 16.0 SULPHUR (WT %): 1.06 (AALUND 83)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 4.40(AALUND 83)

17.2 METALS (PPM): NICKEL: 11(AALUND 83)
VANADIUM: 26(AALUND 83)

17.3 NITROGEN (PPM): 2,090(AALUND 83)

17.4 H₂S (mg/m³): 25.27(AALUND 83)17.5 SALT (g/m³): 2.3606(AALUND 83)

17.6 YIELD ON CRUDE:

	RANGE, °C	VOL %
C ₁ - C ₄		1.17
LIGHT GASOLINE	C ₅ - 65	2.2
NAPHTHA	65 - 193	15.6
DISTILLATE	193 - 343	28.6
GAS OIL	343 - 449	16.4
RESIDUE	343 +	52.4

(AALUND 83)

1.0 TYPE: ALBERTA CRUDE OIL.

2.0 API GRAVITY(15/15°C): 36.8(MACKAY 82A)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (WT %)		
	0	10	20
0	0.850 (MACKAY 82A)		
5	0.846 (MACKAY 82A)		
10	0.843 (MACKAY 82A)		
15	0.840 (MACKAY 82A)		
20	0.835 (MACKAY 82A)	0.855 (MACKAY 82A)	0.866 (MACKAY 82A)
25	0.832 (MACKAY 82A)		
	0.83 (MACKAY 82A)		

NOTE: $DEN = 0.850 - 0.00072T$

WHERE: DEN IS THE DENSITY OF FRESH OIL AT T (g/ml)
T IS OIL TEMPERATURE (°C) (MACKAY 82A)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):
WEATHERING
(%)

TEMP (°C)	0
0	17.6 (MACKAY 82A)
5	12.4 (MACKAY 82A)
10	9.03 (MACKAY 82A)
15	6.43 (MACKAY 82A)
20	4.98 (MACKAY 82A)
25	4.22 (MACKAY 82A)

NOTE: $VISC = EXP((4760/(T+273)) - 14.6)$ WHERE: VISC IS VISCOSITY OF FRESH OIL AT T (mPa.s)
T IS OIL TEMPERATURE (°C) (MACKAY 82A)4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
WEATHERING
(%)

TEMP (°C)	0
0	20.7 (MACKAY 82A)
5	14.7 (MACKAY 82A)
10	10.71 (MACKAY 82A)
15	7.65 (MACKAY 82A)
20	5.96 (MACKAY 82A)
25	5.08 (MACKAY 82A)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

WEATHERING (WT %)	POUR POINT (°C)
0	-24 (MACKAY 82A)
10	12 (MACKAY 82A)
20	15 (MACKAY 82A)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE (kPa):

TEMP (°C)	VAPOUR PRESSURE (kPa)
15.6	35.7 (MACKAY 74)
63	66.9 (MACKAY 74)

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMP (°C)
10	120 (MACKAY 74)
25	187 (MACKAY 74)
40	254 (MACKAY 74)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

	WEATHERING (WT %)		
	0	10	20
PARAFFINS	78.3	80.3	77.0
AROMATICS	17.6	13.0	15.2
POLARS	2.84	3.05	3.66
ASPHALTENES	1.21	3.69	4.12
	(MACKAY 82A)	(MACKAY 82A)	(MACKAY 82A)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 WAX:

WEATHERING
(WT %)WAX CONTENT
(WT %)

0	6.93 (MACKAY 82A)
10	7.21 (MACKAY 82A)
20	10.9 (MACKAY 82A)

1.0 TYPE: ALBERTA SWEET MIXED BLEND CRUDE OIL.
EPS STANDARD OIL FOR DISPERSANT TESTING.

2.0 API GRAVITY (15/15°C): 37.0(EETD 84)

3.0 DENSITY (g/mL):

For Fv below 25.5 % and T between 0 and 15 deg C:

$$\text{DEN} = 0.8475 + 0.00168 \text{ Fv} - 0.0004 \text{ T}$$

where: DEN is density of oil at T and Fv (g/ml)

Fv is volume fraction of oil weathered

T is oil temperature (°C)

TEMP (°C)	WEATHERING (VOL %)		
	0	14.8	25.5
0	0.847(EETD 84)	0.874(EETD 84)	0.888(EETD 84)
15	0.839(EETD 84)	0.868(EETD 84)	0.883(EETD 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)		
	0	14.8	25.5
0	47.3(EETD 85)	7500(EETD 85)	>10000(EETD 85)
15	9.2(EETD 85)	43.5(EETD 85)	48(EETD 85)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (VOL %)		
	0	14.8	25.5
0	55.9(EETD 85)	8581(EETD 85)	>11000(EETD 85)
15	11(EETD 84)	50.1(EETD 85)	54.4(EETD 85)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	14.8	25.5
0	32.0 (EETD 85)	N/M (EETD 84)	N/M (EETD 84)
15	25.6 (EETD 84)	28.1 (EETD 84)	29.4 (EETD 84)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	14.8	25.5
0	17.5 (EETD 85)	N/M (EETD 84)	N/M (EETD 84)
15	8.4 (EETD 84)	8.6 (EETD 84)	15.5 (EETD 84)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	14.8	25.5
0	30.3 (EETD 85)	N/M (EETD 85)	N/M (EETD 85)
15	21.5 (EETD 84)	23.8 (EETD 84)	21.1 (EETD 84)

6.0 POUR POINT:

WEATHERING (VOL %)	POUR POINT (°C)
0	-8 (EETD 85)
14.8	7 (EETD 85)

7.0 FLASH POINT (°C): 7 (C.C.) (EETD 84)

8.0 REID VAPOUR PRESSURE (kPa): 18.6 (EETD 84)

9.0 DISTILLATION DATA ($^{\circ}\text{C}$):

VOLUME PERCENT	WEATHERING (VOL %)			
	0		15.0	
	LIQUID TEMP.	VAPOUR TEMP.	LIQUID TEMP.	VAPOUR TEMP.
IBP	115	37	171	45
5	158	95	213	125
10	182	111	235	148
15	206	126	256	163
20	234	142	276	170
25	260	155	296	183
30	286	198	(EETD 85)	(EETD 85)
34	304	213		
	(EETD 85)	(EETD 85)		

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	14.8	25.5
0	1.0(EETD 84)	1.0(EETD 84)	1.0(EETD 84)
15	0(EETD 84)	0(EETD 84)	1.0(EETD 84)

10.2 EMULSION STABILITY:

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	14.8	25.5
0	1.0(EETD 84)	1.0(EETD 84)	1.0(EETD 84)
15	0.2(EETD 84)	0.2(EETD 84)	1.0(EETD 84)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	14.8	25.5
0	46.7(EETD 84)	90.0(EETD 84)	88.9(EETD 84)
15	N/A(EETD 84)	N/A(EETD 84)	90.0(EETD 84)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 3839.8 \theta \exp(6.3 - 5096.4/TK)/TK)}{(3839.8/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (EETD 84)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
 OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	14.8	25.5
0	73 (EETD 85)	36 (EETD 85)	76 (EETD 85)
15	98 (EETD 85)	73 (EETD 85)	87 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	14.8	25.5
0	7 (EETD 85)	1 (EETD 85)	0 (EETD 85)
15	19 (EETD 85)	11 (EETD 85)	10 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES 84.2
 AROMATICS 12.8
 POLARS 1.2
 ASPHALTENES 1.8 (EETD 86)

14.0 AQUEOUS SOLUBILITY (mg/L):

in distilled water @ 22°C: 34.8 (SUNITO 86)
 in fresh water @ 22 °C: 31.2 (SUNITO 86)
 in salt water @ 22°C: 22.0 (SUNITO 86)
 in fresh water: 16.1 (MACLEAN 88)
 in seawater: 13.66 (MACLEAN 88)

15.0 TOXICITY:

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHIA MAGNA:

48 hour EC50: 1.12 mg/L (MACLEAN 88)

2.2 mg/L (BOBRA 88)

48 hour LC50: 6.28 mg/L (MACLEAN 88)

12.1 mg/L (BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

24 hour EC50: 8.17 mg/L (MACLEAN 88)

14.95 mg/L (BOBRA 88)

24 hour LC50: 10.6 mg/L (MACLEAN 88)

19.3 mg/L (BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE
SPECTROSCOPY.RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP
GC ANALYSIS.

ACUTE TOXICITY TO FROG LARVAE (freshwater):

96 hour LC50, water soluble fraction, static test: 250 mL/L (HEDTKE 82)

96 hour LC50, oil-in-water emulsion, static test: 78 uL/L (HEDTKE 82)

96 hour LC50, oil-in-water emulsion, flowthrough: 28.2 uL/L (HEDTKE 82)

96 hour LC50, floating oil layer, static test: 2.5 uL/L (HEDTKE 82)

ACUTE TOXICITY OF OIL-IN-WATER EMULSION TO FATHEAD MINNOW (freshwater):

96 hour LC50, static test: 8.4 uL/L (HEDTKE 82)

16.0 SULPHUR:

WEATHERING
(VOL %)SULPHUR CONTENT
(WT %)

0

0.55 (EETD 86)

15.0

0.61 (EETD 86)

23.4

0.66 (EETD 86)

17.0 OTHERS:

1.0 TYPE: AMAULIGAK CRUDE OIL.

2.0 API GRAVITY: 31 to 35.5(OIL 86)
27.4(15/15°C)(EETD 85)

3.0 DENSITY (g/mL):

For Fv < 19.4 % & T between 0 and 15 °C:

$$\text{DEN} = 0.900496 + 0.000717 \text{ Fv} - 0.000698 \text{ T}$$

where: DEN is density of oil at T and Fv (g/mL)

Fv is volume percent of oil weathered

T is oil temperature (°C)

TEMP (°C)	WEATHERING (VOL %)		
	0	13.4	19.4
0	0.9014 (EETD 85)	0.9090 (EETD 85)	0.9146 (EETD 85)
15	0.8896 (EETD 85)	0.8992 (EETD 85)	0.9048 (EETD 85)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)		
	0	13.4	19.4
0	25.0 (EETD 85)	41.9 (EETD 85)	67.5 (EETD 85)
15	14.0 (EETD 85)	21.0 (EETD 85)	32.2 (EETD 85)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (VOL %)		
	0	13.4	19.4
0	27.7 (EETD 85)	46.1 (EETD 85)	73.8 (EETD 85)
15	15.7 (EETD 85)	23.4 (EETD 85)	35.6 (EETD 85)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
0	13.4	19.4	
0	30.0 (EETD 85)	31.1 (EETD 85)	31.3 (EETD 85)
15	29.2 (EETD 85)	29.0 (EETD 85)	28.5 (EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
0	13.4	19.4	
0	21.1 (EETD 85)	19.7 (EETD 85)	17.8 (EETD 85)
15	20.9 (EETD 85)	15.0 (EETD 85)	15.1 (EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
0	13.4	19.4	
0	27.5 (EETD 85)	21.6 (EETD 85)	20.8 (EETD 85)
15	21.5 (EETD 85)	20.4 (EETD 85)	19.6 (EETD 85)

6.0 POUR POINT:

WEATHERING (WT %)	POUR POINT (°C)
0	<-25 (EETD 85) -66 (EETD 86)
13.4	-48 (EETD 86)

7.0 FLASH POINT (°C): 0 (C.C.) (EETD 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	198	66
5	216	134
10	238	156
15	259	172
20	275	187
25	289	194
29	301	246
	(EETD 85)	(EETD 85)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (VOL %)		
	0	13.4	19.4
0	0 (EETD 85)	0 (EETD 85)	1.0 (EETD 85)
15	0 (EETD 85)	0 (EETD 85)	0 (EETD 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (VOL %)		
	0	13.4	19.4
0	0.29 (EETD 85)	0.13 (EETD 85)	0.78 (EETD 85)
15	0 (EETD 85)	0 (EETD 85)	0 (EETD 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	13.4	19.4
0	91.3 (EETD 85)	92.0 (EETD 85)	78.8 (EETD 85)
15	N/A (EETD 85)	N/A (EETD 85)	N/A (EETD 85)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 3811 \theta \exp(6.3 - 4851/TK)/TK)}{(3811/TK)}$$

where: Fv is fraction of oil weathered by volume
 ln is natural log
 θ is evaporation exposure
 exp is exponential base e
 TK is environmental temperature
 (Kelvin, K = °C + 273)
 (EETD 85)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
 OIL TO DISPERSANT RATIO : 20 TO 1

TEMP (°C)	WEATHERING (VOL %)		
	0	13.4	19.4
0	93 (EETD 85)	84 (EETD 85)	74 (EETD 85)
15	71 (EETD 85)	65 (EETD 85)	68 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	13.4	19.4
0	50 (EETD 85)	13 (EETD 85)	22 (EETD 85)
15	14 (EETD 85)	28 (EETD 85)	6 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES 89.5
 AROMATICS 9.3
 POLARS 0.4
 ASPHALTENES 0.8 (EETD 86)

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22°C: 9.6 (SUNTIO 86)
 in fresh water: 9.1 (MACLEAN 88)
 in seawater: 6.54 (MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

48 hour EC50: 1.66(MACLEAN 88)

1.8(BOBRA 88)

48 hour LC50: 6.73(MACLEAN 88)

7.2(BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

24 hour EC50: 6.40(MACLEAN 88)

7.54(BOBRA 88)

24 hour LC50: >6.54(MACLEAN 88)

>7.7(BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE SPECTROSCOPY.

RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP GC ANALYSIS.

16.0 SULPHUR (WT %): 0.15(EETD 86)

17.0 OTHERS:

1.0 TYPE: ARABIAN CRUDE OIL.

2.0 API GRAVITY: 32.5(API 81)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.862(API 81)

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT -----	TEMPERATURE (°C) -----
IBP	29
5	69
10	100
15	128
20	151
25	172
30	198
35	213
40	238
45	261
50	282
55	304
60	329
65	351
70	373
75	398
80	422
85	448
90	475
95	504
FBP	537

(API 81)

NOTE: DATA FROM SIMULATED DISTILLATION METHOD ASTM D 2887

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 1.87 (API 81)

17.0 OTHERS:

17.1 NITROGEN (WT %): 0.088 (API 81)

17.2 METALS (PPM): NICKEL: 14 (API 81)
VANADIUM: 3.7 (API 81)

1.0 TYPE: ARABIAN HEAVY CRUDE OIL.

2.0 API GRAVITY: 27.9(AALUND 83B)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (VOL %)			
	0	14.7	22.7	30.2
15.5	0.887 (DALING 87)	0.920 (DALING 87)	0.935 (DALING 87)	0.951 (DALING 87)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)			
	0	14.7	22.7	30.2
6	75 (DALING 87)	386 (DALING 87)	1305 (DALING 87)	6574 (DALING 87)
13	41 (DALING 87)	241 (DALING 87)	700 (DALING 87)	2344 (DALING 87)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

@ 21.1°C: 37.0(AALUND 83B)

@ 37.8°C: 19.0(AALUND 83B)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL:

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)			
	0	14.7	22.7	30.2
13	20 (DALING 87)	16 (DALING 87)	15 (DALING 87)	16 (DALING 87)

5.3 OIL-WATER:

6.0 POUR POINT (°C):

WEATHERING
(VOL %)POUR POINT
(°C)

-----	-----
0	-28 (DALING 87) -28.9 (AALUND 83B)
14.7	-23 (DALING 87)
22.7	-18 (DALING 87)
30.2	-5 (DALING 87)
-----	-----

7.0 FLASH POINT:

8.0 REID VAPOUR PRESSURE (kPa): 51.71 (AALUND 83B)

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

For oil weathered 30.2 % by volume:

SATURATES	23.2
AROMATICS	49.0
POLARS	18.4
ASPHALTENES	9.5 (DALING 87)

WEATHERING
(VOL %)

ASPHALTENES

"hard"

"soft"

-----	-----	-----
0	4.35 (DALING 87)	7.38 (DALING 87)
14.7	4.89 (DALING 87)	8.34 (DALING 87)
22.7	5.31 (DALING 87)	9.05 (DALING 87)
30.2	5.80 (DALING 87)	9.98 (DALING 87)
-----	-----	-----

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 2.85 (AALUND 83B)

17.0 OTHERS:

17.1 WAX (WT %):

WEATHERING
(VOL %)WAX CONTENT
(WT %)

0	4.62 (DALING 87)
14.7	5.22 (DALING 87)
22.7	5.67 (DALING 87)
30.2	6.19 (DALING 87)

17.2 YIELD ON CRUDE:

	RANGE, °C	VOL %
LIGHT NAPHTHA	20 - 100	7.9
HEAVY NAPHTHA	100 - 150	6.8
KEROSINE	150 - 235	12.4
LIGHT GAS OIL	235 - 343	16.5
HEAVY GAS OIL	343 - 565	30.6
RESIDUAL OIL	565 +	23.2

(AALUND 83B)

1.0 TYPE: ATHABASCA BITUMEN. SYNCRUDE CANADA LTD.
COKER FEED BITUMEN PRODUCED BY THE HOT WATER PROCESS.

2.0 API GRAVITY: 7.7 to 9.0 (ARC 87)

3.0 DENSITY (g/mL): 1.006 to 1.016 (ARC 87)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

WEATHERING

(%)

TEMP
(°C)

0

15 19,000 to >700,000 (ARC 87)

25 5,320 to 300,000 (ARC 87)

60 3,630 to 4,350 (ARC 87)

100 160 to 303 (ARC 87)

4.2 KINEMATIC VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):
ASPHALTENES 4.41 to 5.44 (ARC 87)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 4.41 to 5.44 (ARC 87)

17.0 OTHERS:

17.1 CARBON (WT %): 82.41 to 83.95(ARC 87)

17.2 HYDROGEN (WT %): 10.16 to 10.63(ARC 87)

17.3 NITROGEN (WT %): 0.44 to 0.92(ARC 87)

17.4 OXYGEN (WT %): 0.76 to 1.38(ARC 87)

17.5 METALS (PPM WT):

VANADIUM 81 to 218(ARC 87)

NICKEL 69 to 85.2(ARC 87)

17.6 RAMSBOTTOM CARBON RESIDUE (WT %): 11.5 to 14.5(ARC 87)

17.7 ASH (WT %): 0.70 to 1.03(ARC 87)

17.8 ACID NUMBER: 1.57 to 2.58(ARC 87)

1.0 TYPE: ATKINSON CRUDE OIL.

2.0 API GRAVITY (15/15°C): 23.7(EETD 84)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)		
	0	4	12
0	0.9219(EETD 85)		
15	0.911(EETD 84)		
20	0.9060(ESSO 83)	0.9172(ESSO 83)	0.9239(ESSO 83)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (%)		
	0	4	12
-10	304.8(ESSO 83)	762.7(ESSO 83)	2506(ESSO 83)
0	136.2(ESSO 83)	317.0(ESSO 83)	783.7(ESSO 83)
15	57.28(ESSO 83)	113.6(ESSO 83)	245.0(ESSO 83)
25	34.94(ESSO 83)	62.05(ESSO 83)	124.4(ESSO 83)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	30.5 (EETD 85)
15	28.8 (EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	18.7 (EETD 85)
15	17.9 (EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	24.2 (EETD 85)
15	23.2 (EETD 85)

6.0 POUR POINT:

WEATHERING (%)	POUR POINT (°C)
0	-38 (ESSO 83)
4	-35 (ESSO 83)
12	-28 (ESSO 83)

7.0 FLASH POINT:

WEATHERING (%)	FLASH POINT (°C)
0	10 (ESSO 83)
4	32 (ESSO 83)
12	75 (ESSO 83)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	173	58
5	210	106
10	252	123
15	290	129
17	304	201
	(EETD 85)	(EETD 85)

PERCENT CONDENSED (VOL %)	WEATHERING (%)		
	0	4	12
IBP	40 (ESSO 83)	88 (ESSO 83)	131 (ESSO 83)
50	372 (ESSO 83)	383 (ESSO 83)	404 (ESSO 83)
FINAL	555 (ESSO 83)	553 (ESSO 83)	556 (ESSO 83)
FINAL VOL	81 % (ESSO 83)	79 % (ESSO 83)	77 % (ESSO 83)

10.0 EMULSION FORMATION & TENDENCY:

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 8039 \theta \exp(6.3 - 4591/TK)/TK)}{(8039/TK)}$$

where: Fv is fraction of oil weathered by volume
 ln is natural log
 θ is evaporation exposure
 exp is exponential base e
 TK is environmental temperature
 (Kelvin, K = °C + 273)
 (EETD 85)

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	82.7
AROMATICS	13.2
POLARS	1.5
ASPHALTENES	2.6 (EETD 86)

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22°C:	3.1(SUNTIO 86)
in fresh water:	2.3(MACLEAN 88)
in seawater:	2.5(MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

48 hour EC50:	0.61(MACLEAN 88)
	0.83(BOBRA 88)
48 hour LC50:	>2.27(MACLEAN 88)
	>3.1(BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

24 hour EC50:	>2.03(MACLEAN 88)
	>2.5(BOBRA 88)
24 hour LC50:	>2.03(MACLEAN 88)
	>2.5(BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE SPECTROSCOPY.
RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP GC ANALYSIS.

16.0 SULPHUR (WT %): 0.86(EETD 86)

17.0 OTHERS:

17.1 FIRE POINT:

WEATHERING (%)	FIRE POINT (°C)
0	26(ESSO 83)
4	50.5(ESSO 83)
12	95(ESSO 83)

1.0 TYPE: AUK CRUDE OIL, U.K. NORTH SEA.

2.0 API GRAVITY: 37.5(HMSO 76)
37.15(AALUND 83D)

3.0 DENSITY (g/mL):
@ 15 °C: 0.837(HMSO 76)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 15 °C: 3.65(HMSO 76)
@ 40 °C: 4.38(AALUND 83D)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -1 (-10)(HMSO 76)
9(AALUND 83D)

NOTE: FIGURE IN BRACKETS WAS OBTAINED FROM
THE OIL INDUSTRY AND IS NOT IN AGREEMENT WITH THE
PUBLISHED DATA. (HMSO 76)

7.0 FLASH POINT:

8.0 REID VAPOUR PRESSURE (kPa): 41.4(AALUND 83D)

9.0 DISTILLATION DATA:

WEIGHT PERCENT	TEMP (°C)
9.5	5 TO 100(HMSO 76)
10.6	100 TO 160(HMSO 76)
16.6	160 TO 250(HMSO 76)
18.8	250 TO 350(HMSO 76)
44.5	>350(HMSO 76)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.4 (HMSO 76)
0.45 (AALUND 83D)

17.0 OTHERS:

17.1 WAX (WT %): 7 (HMSO 76)
6.5 (AALUND 83D)

17.2 H₂S EXISTENT (PPM): <1 (AALUND 83D)
H₂S POTENTIAL (PPM): <1 (AALUND 83D)

17.3 ACID NUMBER (mg KOH/g): 0.13 (AALUND 83D)

17.4 YIELD ON CRUDE:

	RANGE, °C	VOL %	WT %
C ₁ - C ₄		2.2	1.5
GASOLINE	C ₅ - 85	8.0	6.5
NAPHTHA	85 - 165	15.5	14.0
KEROSINE	165 - 235	13.0	12.5
GAS OIL	235 - 300	12.5	12.4
GAS OIL	300 - 350	9.4	9.6
RESIDUE	350 +	39.2	43.5

(AALUND 83D)

1.0 TYPE: AVALON CRUDE OIL.

2.0 API GRAVITY(15/15°C): 36.0(EETD 84)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (WT %)		
	0	9.0	20.3
0	0.851(EETD 84)	0.867(EETD 84)	0.897(EETD 84)
15	0.844(EETD 84)	0.856(EETD 84)	0.886(EETD 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (WT %)		
	0	9.0	20.3
0	575(EETD 84)	>1000(EETD 84)	>5200(EETD 84)
15	11.4(EETD 84)	83(EETD 84)	438(EETD 84)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (WT %)		
	0	9.0	20.3
0	675.7(EETD 84)	>1150(EETD 84)	>5780(EETD 84)
15	13.5(EETD 84)	97(EETD 84)	94.4(EETD 84)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (WT %)		
	0	9.0	20.3
0	28.0 (EETD 84)	28.4 (EETD 84)	N/M (EETD 84)
15	26.4 (EETD 84)	25.8 (EETD 84)	27.9 (EETD 84)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (WT %)		
	0	9.0	20.3
0	25.2 (EETD 84)	33.2 (EETD 84)	N/M (EETD 84)
15	20.5 (EETD 84)	25.6 (EETD 84)	26.7 (EETD 84)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (WT %)	
	0	
0	49.4 (EETD 85)	
15	29.1 (EETD 85)	

6.0 POUR POINT (°C):

WEATHERING (WT %)	POUR POINT (°C)
0	12 (EETD 84)
9.0	21 (EETD 84)
20.3	24 (EETD 84)

7.0 FLASH POINT ($^{\circ}\text{C}$):WEATHERING
(WT %)FLASH POINT
($^{\circ}\text{C}$)

-----	-----
0	14 (EETD 84)
9	33 (EETD 84)
20.3	66 (EETD 84)
-----	-----

8.0 REID VAPOUR PRESSURE (kPa): 63.5 (EETD 84)

9.0 DISTILLATION DATA ($^{\circ}\text{C}$):WEATHERING
(VOL %)

	0		15.5	
-----	-----	-----	-----	-----
VOLUME PERCENT	LIQUID TEMP.	VAPOUR TEMP.	LIQUID TEMP.	VAPOUR TEMP.
IBP	146	44	229	122
5	189	95	259	149
10	218	118	289	171
15	248	138	(EETD 85)	(EETD 85)
20	279	158		
25	313	177		
	(EETD 85)	(EETD 85)		
-----	-----	-----	-----	-----

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (WT %)		
	0	9.0	20.3
0	1.0 (EETD 84)	1.0 (EETD 84)	0.24 (EETD 84)
15	0.16 (EETD 84)	0.22 (EETD 84)	1.0 (EETD 84)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (WT %)		
	0	9.0	20.3
0	1.0 (EETD 84)	1.0 (EETD 84)	1.0 (EETD 84)
15	0.37 (EETD 84)	0.71 (EETD 84)	1.0 (EETD 84)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (WT %)		
	0	9.0	20.3
0	88 (EETD 84)	87 (EETD 84)	69 (EETD 84)
15	89 (EETD 84)	89 (EETD 84)	88 (EETD 84)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 5974 \theta \exp(6.3 - 4141/TK)/TK)}{(5974/TK)}$$

where: F_v is fraction of oil weathered by volume

$\ln$ is natural log

θ is evaporation exposure

$\exp$ is exponential base e

TK is environmental temperature

(Kelvin, $K = ^\circ C + 273$)

(EETD 84)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)	
	0	
0	20 (EETD 85)	
15	40 (EETD 85)	

12.1 CHEMICAL DISPERSIBILITY (con't):

OIL TO DISPERSANT RATIO AT 50% DISPERSION

TEMP (°C)	WEATHERING (WT %)		
	0	9.0	20.3
0	<10 (EETD 84)	<10 (EETD 84)	<10 (EETD 84)
15	37 (EETD 84)	14 (EETD 84)	<10 (EETD 84)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (WT %)		
	0	9.0	20.3
0	0 (EETD 85)	0 (EETD 85)	0 (EETD 85)
15	0 (EETD 85)	0 (EETD 85)	0 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	83.2
AROMATICS	12.5
POLARS	1.8
ASPHALTENES	2.5 (EETD 86)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

WEATHERING
(WT %)SULPHUR CONTENT
(WT %)-----
0-----
0.71 (EETD 86)

15.5

0.86 (EETD 86)

17.0 OTHERS:

1.0 TYPE: AVIATION GASOLINE 80.
BLEND OF CATALYTICALLY CRACKED AND STRAIGHT-RUN
NAPHTHAS, ALKYLATES, AND ISOPENTANE.
OPERATIONAL FUEL FOR MANY SMALL PISTON ENGINE AIRCRAFT.
DYED RED FOR IDENTIFICATION.(ESSO 73)

3.0 API GRAVITY:

3.0 DENSITY:

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE (kPa):
@ 38°C: 46.9(ESSO 73)
@ 38°C: maximum, 48(ASTM D 910)

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
-----	-----
10, max	75(ASTM D 910)
26	75(ESSO 73)
40, min	75(ASTM D 910)
50, max	105(ASTM D 910)
89	105(ESSO 73)
90, max	135(ASTM D 910)
95	135(ESSO 73)
FBP, max	170(ASTM D 910)
FBP	147(ESSO 73)
-----	-----

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): maximum, 0.05(ASTM D 910)
0.01(ESSO 73)

17.0 OTHERS:

17.1 FREEZING POINT (°C): maximum, -58 (ASTM D 910)
 <-71 (ESSO 73)

17.2 TEL CONTENT (mL/L): maximum, 0.13 (ASTM D 910)
0.08 (ESSO 73)

17.3 COLOUR: RED(ESSO 73) (ASTM D 910)

17.4 ANTIOXIDANTS (mg/L): maximum, 12 (ASTM D 910)

1.0 TYPE: AVIATION GASOLINE 100.
BLEND OF CATALYTICALLY CRACKED NAPHTHAS, ALKYLATE, AND
ISOPENTANE. OPERATIONAL FUEL FOR MOST COMMERCIAL PISTON
ENGINE AIRCRAFT.
DYED GREEN FOR IDENTIFICATION. (ESSO 73)

3.0 API GRAVITY:

3.0 DENSITY:

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE (kPa):
@ 38°C: 46.9 (ESSO 73)
@ 38°C: maximum, 48 (ASTM D 910)

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
-----	-----
10, max	75 (ASTM D 910)
22	75 (ESSO 73)
40, min	75 (ASTM D 910)
50, max	105 (ASTM D 910)
76	105 (ESSO 73)
90, max	135 (ASTM D 910)
97	135 (ESSO 73)
FBP, max	170 (ASTM D 910)
FBP	159 (ESSO 73)
-----	-----

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): maximum, 0.05 (ASTM D 910)
0.02 (ESSO 73)

17.0 OTHERS:

17.1 FREEZING POINT (°C): maximum, -58 (ASTM D 910)
 <-71 (ESSO 73)

17.2 TEL CONTENT (mL/L): maximum, 1.06 (ASTM D 910)
0.502 (ESSO 73)

17.3 COLOUR: GREEN (ESSO 73) (ASTM D 910)

17.4 ANTIOXIDANTS (mg/L): maximum, 12 (ASTM D 910)

1.0 TYPE: AVIATION GASOLINE 100LL.
BLEND OF CATALYTICALLY CRACKED NAPHTHAS, ALKYLATE, AND
ISOPENTANE. OPERATIONAL FUEL FOR MOST COMMERCIAL PISTON
ENGINE AIRCRAFT. SIMILAR TO GRADE 100 EXCEPT WITH LOWER
LEAD-ADDITIVE CONTENT.
DYED BLUE FOR IDENTIFICATION. (ASTM D 910)

3.0 API GRAVITY:

3.0 DENSITY:

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE (kPa):
@ 38°C: maximum, 48 (ASTM D 910)

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
-----	-----
10, max	75 (ASTM D 910)
40, min	75 (ASTM D 910)
50, max	105 (ASTM D 910)
90, max	135 (ASTM D 910)
FBP, max	170 (ASTM D 910)
-----	-----

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): maximum, 0.05 (ASTM D 910)

17.0 OTHERS:

17.1 FREEZING POINT ($^{\circ}\text{C}$): maximum, -58 (ASTM D 910)

17.2 TEL CONTENT (mL/L): maximum, 0.53 (ASTM D 910)

17.3 COLOUR: BLUE (ASTM D 910)

17.4 ANTIOXIDANTS (mg/L): maximum, 12 (ASTM D 910)

1.0 TYPE: AVIATION GASOLINE 115.
BLEND OF HIGH-OCTANE, QUALITY HYDROCARBON COMPONENTS.
OPERATIONAL FUEL FOR MOST MILITARY PISTON ENGINE
AIRCRAFT. DYED PURPLE FOR IDENTIFICATION. (ESSO 73)

3.0 API GRAVITY:

3.0 DENSITY:

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE (kPa):
@ 38°C: 46.9 (ESSO 73)

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
21	75
62	105
96	135
FBP	161 (ESSO 73)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.02 (ESSO 73)

17.0 OTHERS:

17.1 FREEZING POINT ($^{\circ}\text{C}$): <-71 (ESSO 73)

17.2 TEL CONTENT (mL/L): maximum, 1.215 (ESSO 73)
1.19 (ESSO 73)

17.3 COLOUR: PURPLE (ESSO 73)

1.0 TYPE: BENT HORN CRUDE OIL. DATA FOR EETD 1985 FROM
DRILL STEMP TESTING SAMPLE OF A-02 WELL, 1985.

2.0 API GRAVITY: 42(OILWEEK 85)

3.0 DENSITY (g/mL):

For Fv < 32.9% & T between -43 and 18 °C:

DEN = 0.829837 + 0.001326 Fv - 0.000627 T

where: DEN is density of oil at T and Fv (g/mL)

Fv is volume percent of oil weathered

T is oil temperature (°C)

TEMP (°C)	WEATHERING (VOL %)		
	0	20.4	32.9
-43	0.852(CHARLES 84)		
-15	0.845(CHARLES 84)		
0	0.8299(EETD 85) 0.833(CHARLES 84)	0.8600(EETD 85)	0.8735(EETD 85)
15	0.8177(EETD 85) 0.821(CHARLES 84)	0.8484(EETD 85)	0.8615(EETD 85)
18	0.815(CHARLES 84)		

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

$VISC = EXP (4278 / (T + 273) - 12.32)$ (CHARLES 84)
where: VISC is dynamic viscosity (mPa.s) of fresh oil at T
T is oil temperature (°C)
EXP is exponential base e

TEMP (°C)	WEATHERING (VOL %)		
	0	20.4	32.9
-43	44000(CHARLES 84)		
-30	17430(CHARLES 84)		
-20	580(CHARLES 84)		
-10	207(CHARLES 84)		
0	68(CHARLES 84) 25.0(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	12.1(EETD 85)	100(EETD 85)	525(EETD 85)

4.2 KINEMATIC VISCOSITY:

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	20.4	32.9
0	27.4 (EETD 85)	31.1 (EETD 85)	N/M (EETD 85)
15	25.4 (EETD 85)	27.9 (EETD 85)	28.7 (EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	20.4	32.9
0	34.4 (EETD 85)	26.7 (EETD 85)	N/M (EETD 85)
15	17.6 (EETD 85)	1.7 (EETD 85)	2.3 (EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	20.4	32.9
0	30.0 (EETD 85)	38.9 (EETD 85)	N/M (EETD 85)
15	26.6 (EETD 85)	13.8 (EETD 85)	11.4 (EETD 85)

6.0 POUR POINT (°C):

WEATHERING (VOL %)	POUR POINT (°C)
0	-16 (EETD 85) -18 TO 21 (OILWEEK 85)
20.4	-2 (EETD 85)
32.9	11 (EETD 85)

7.0 FLASH POINT (°C): -14 (C.C.) (EETD 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	133	33
5	158	92
10	180	113
15	203	130
20	228	149
25	253	169
30	279	188
35	303	206
	(EETD 85)	(EETD 85)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (VOL %)		
	0	20.4	32.9
0	0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)
15	0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (VOL %)		
	0	20.4	32.9
0	0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)
15	0(EETD 85)	0.54(EETD 85)	1.0(EETD 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	20.4	32.9
0	N/A(EETD 85)	53.8(EETD 85)	77.3(EETD 85)
15	N/A(EETD 85)	47.6(EETD 85)	86.0(EETD 85)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 4985 \theta \exp(6.3 - 4182/TK)/TK)}{(4985/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (EETD 85)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	20.4	32.9
0	86 (EETD 85)	12 (EETD 85)	<1 (EETD 85)
15	69 (EETD 85)	81 (EETD 85)	69 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	20.4	32.9
0	2 (EETD 85)	0 (EETD 85)	0 (EETD 85)
15	5 (EETD 85)	0 (EETD 85)	9 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	95.0	
AROMATICS	4.3	
POLARS	0.3	
ASPHALTENES	0.4	(EETD 86)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %):

WEATHERING
(VOL %)SULPHUR CONTENT
(WT %)

0	0.76 (EETD 86)
20.4	0.81 (EETD 86)
32.9	0.89 (EETD 86)

17.0 OTHERS:

17.1 COMPOSITIONAL ANALYSIS:

COMPONENT	MOLE %
N ₂	0.16
CO ₂	0.15
H ₂ S	0.03
C ₁	7.12
C ₂	2.75
C ₃	2.85
iC ₄	1.30
C ₄	3.21
iC ₅	2.28
C ₅	2.91
C ₆	5.74
C ₇	6.00
C ₈	6.95
C ₉	5.49
C ₁₀	5.49
C ₁₁	4.80
C ₁₂	3.78
C ₁₃	3.98
C ₁₄	3.58
C ₁₅	2.65
C ₁₆	2.24
C ₁₇	2.25
C ₁₈	1.91
C ₁₉	1.53
C ₂₀	1.39
C ₂₁	1.16
C ₂₂	1.08
C ₂₃	0.97
C ₂₄	0.82
C ₂₅	0.79
C ₂₆	0.68
C ₂₇	0.65
C ₂₈	0.63
C ₂₉	0.54
C ₃₀₊	5.83

17.1 COMPOSITIONAL ANALYSIS (continued):

COMPONENT	MOLE %
AROMATICS:	
C ₆ H ₆	0.08
C ₇ H ₈	0.29
C ₈ H ₁₀	0.74
C ₈ H ₁₀	0.91
C ₉ H ₁₂	0.45
NAPHTHENES:	
C ₅ H ₁₀	0.36
C ₆ H ₁₂	0.60
C ₆ H ₁₂	0.64
C ₇ H ₁₄	2.14

(PANARTIC 84)

1.0 TYPE: BENT HORN CRUDE OIL.
DATA FOR SAMPLE TAKEN FROM THE IMPERIAL BEDFORD TANKER
ON SEPTEMBER 10, 1985 AT THE PORT OF MONTREAL.

2.0 API GRAVITY(15/15°C): 41.3(EETD 85)

3.0 DENSITY (g/mL):

For Fv < 33.3% & T between 0 and 15 °C:
 $DEN = 0.830471 + 0.001329 Fv - 0.000784 T$
where: DEN is density of oil at T and Fv (g/mL)
Fv is volume percent of oil weathered
T is oil temperature (°C)

TEMP (°C)	WEATHERING (VOL %)		
	0	20.2	33.3
0	0.8298(EETD 85)	0.8589(EETD 85)	0.8738(EETD 85)
15	0.8181(EETD 85)	0.8472(EETD 85)	0.8619(EETD 85)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)		
	0	20.2	33.3
0	53.8(EETD 85)	14750(EETD 85)	110000(EETD 85)
15	24.0(EETD 85)	60.0(EETD 85)	5820(EETD 85)

4.2 KINEMATIC VISCOSITY:

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
0	20.2	33.3	
0	27.7 (EETD 85)	33.1 (EETD 85)	N/M (EETD 85)
15	26.2 (EETD 85)	28.2 (EETD 85)	25.0 (EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
0	20.2	33.3	
0	53.5 (EETD 85)	32.1 (EETD 85)	N/M (EETD 85)
15	38.5 (EETD 85)	2.2 (EETD 85)	7.4 (EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
0	20.2	33.3	
0	48.0 (EETD 85)	42.3 (EETD 85)	N/M (EETD 85)
15	39.1 (EETD 85)	16.6 (EETD 85)	15.4 (EETD 85)

6.0 POUR POINT (°C):

WEATHERING (VOL %)	POUR POINT (°C)
0	-18 (EETD 85)
20.2	-7 (EETD 85)
33.3	8 (EETD 85)

7.0 FLASH POINT (°C): -9 (C.C) (EETD 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	111	33
5	164	89
10	187	110
15	210	130
20	235	147
25	259	174
30	284	188
34	305	203
	(EETD 85)	(EETD 85)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (VOL %)		
	0	20.2	33.3
0	0 (EETD 85)	1.0 (EETD 85)	1.0 (EETD 85)
15	0 (EETD 85)	1.0 (EETD 85)	1.0 (EETD 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (VOL %)		
	0	20.2	33.3
0	0 (EETD 85)	1.0 (EETD 85)	1.0 (EETD 85)
15	0 (EETD 85)	1.0 (EETD 85)	1.0 (EETD 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	20.2	33.3
0	N/A (EETD 85)	59.6 (EETD 85)	66.0 (EETD 85)
15	N/A (EETD 85)	13.6 (EETD 85)	44.4 (EETD 85)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 4944 \theta \exp(6.3 - 4254/TK)/TK)}{(4944/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (EETD 85)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
 OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP ($^{\circ}C$)	WEATHERING (VOL %)		
	0	20.2	33.3
0	54 (EETD 85)	5 (EETD 85)	0 (EETD 85)
15	60 (EETD 85)	63 (EETD 85)	5 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP ($^{\circ}C$)	WEATHERING (VOL %)		
	0	20.2	33.3
0	<1 (EETD 85)	0 (EETD 85)	0 (EETD 85)
15	4 (EETD 85)	6 (EETD 85)	5 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	94.3	
AROMATICS	4.8	
POLARS	0.3	
ASPHALTENES	0.6	(EETD 86)

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22 $^{\circ}C$:	7.6 (SUNTIO 86)
in fresh water:	6.4 (MACLEAN 88)
in salt water @ 22 $^{\circ}C$:	6.0 (SUNTIO 86)
in seawater:	5.34 (MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHIA MAGNA:

48 hour EC50: 1.07(MACLEAN 88)
1.3(BOBRA 88)48 hour LC50: 1.75(MACLEAN 88)
2.1(BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

48 hour EC50: 3.39(MACLEAN 88)
3.87(BOBRA 88)48 hour LC50: 4.49(MACLEAN 88)
5.1(BOBRA 88)NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE
SPECTROSCOPY.RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP
GC ANALYSIS.

16.0 SULPHUR (WT %): 0.82(EETD 86)

17.0 OTHERS:

1.0 TYPE: BOW RIVER BLENDED CRUDE OIL.

2.0 API GRAVITY: 26.7(AALUND 83A)

3.0 DENSITY (g/mL):

$$\text{DEN} = 0.901 - 0.000617 T$$

WHERE: DEN IS THE DENSITY OF FRESH OIL AT T (mPa.s)

T IS OIL TEMPERATURE ($^{\circ}\text{C}$) (MACKAY 82A)

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	0.900 (MACKAY 82A)	
5	0.899 (MACKAY 82A)	
10	0.896 (MACKAY 82A)	
15	0.893 (MACKAY 82A)	
15.5	0.8936 (AALUND 83A)	
20	0.889 (MACKAY 82A)	
25	0.885 (MACKAY 82A)	
0.923 @ 10 WT% WEATHERING & 0.938 @ 20 WT% WEATHERING (MACKAY 82A)		
0.90 @ ROOM TEMP (TWARDUS 80)		

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

$$\text{VISC} = \text{EXP}((4310/(T+273)) - 11.4)$$

WHERE: VISC IS VISCOSITY OF FRESH OIL AT T (mPa.s)

T IS TEMP (°C) (MACKAY 82A)

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	88.4 (MACKAY 82A) 74 (TWARDUS 80)	
5	62.0 (MACKAY 82A)	
10	45.1 (MACKAY 82A) 67 (TWARDUS 80)	
15	33.7 (MACKAY 82A)	
20	28.3 (MACKAY 82A) 42.5 (TWARDUS 80)	
25	23.7 (MACKAY 82A)	

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	98.2 (MACKAY 82A)	
5	69.0 (MACKAY 82A)	
10	50.3 (MACKAY 82A)	
15	37.7 (MACKAY 82A)	
20	31.8 (MACKAY 82A)	
25	26.8 (MACKAY 82A)	
40	18.30 (AALUND 83A)	

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

@ ROOM TEMP: 15(TWARDUS 80)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

WEATHERING
(WT %)INTERFACIAL TENSION
(mN/m or dynes/cm)

0	26.8(MACKAY 82A)
10	23.9(MACKAY 82A)
20	27.8(MACKAY 82A)

5.3 OIL-WATER (mN/m or dynes/cm):

@ ROOM TEMP: 28.85(TWARDUS 80)

6.0 POUR POINT (°C):

WEATHERING
(WT %)POUR POINT
(°C)

0	-39(MACKAY 82A) -27(TWARDUS 80) -50.0(AALUND 83A)
10	-15(MACKAY 82A)
20	-3(MACKAY 82A)

7.0 FLASH POINT (°C): <12(O.C.) (TWARDUS 80)

8.0 REID VAPOUR PRESSURE (kPa): 37.2(AALUND 83A)

9.0 DISTILLATION DATA:

VOLUME
PERCENTTEMP
(°C)

0	45.95
10	115
20	185
30	265
40	310
50	350
60	370
70	385
80	390(TWARDUS 80)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

GROUP	WEATHERING (WT %)		
	0	10	20
PARAFFINS	69.6	66.7	62.5
AROMATICS	21.4	22.4	25.8
POLARS	3.96	3.36	3.87
ASPHALTENES	5.04	7.50	7.80

(MACKAY 82A)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (PPM): 21,000 (AALUND 83A)

17.0 OTHERS:

17.1 FIRE POINT (°C): 22 (TWARDUS 80)

17.2 IN-SITU COMBUSTION RESULTS :

FRESH OIL IGNITED EASILY, RESIDUE 6.1 VOL% (TWARDUS 80)

17.3 WAX (WT %):

WEATHERING (WT %)	WAX (WT %)
0	2.75 (MACKAY 82A)
10	6.47 (MACKAY 82A)
20	8.63 (MACKAY 82A)

17.4 CON. CARBON (WT %): 6.7 (AALUND 83A)

17.5 METALS (PPM): NICKEL: 20.7 (AALUND 83A)
VANADIUM: 54.0 (AALUND 83A)

17.6 YIELD ON CRUDE:

	<u>RANGE, °C</u>	<u>VOL %</u>
NAPHTHA	C ₅ - 190	20.40
KEROSINE	190 - 277	13.10
DISTILLATE	277 - 343	10.80
GAS OIL	343 - 565	32.50
RESIDUE	565 +	23.20

(AALUND 83A)

1.0 TYPE: BUNKER C FUEL OIL OR FUEL OIL NUMBER 6.

2.0 API GRAVITY: 14.1(API 81)
10(FINGAS 79)
7.3(PANCIROV 74)
15.5(YUEN 70)
12.3(EETD 88)

3.0 DENSITY(g/mL):

For T between 0 and 30 °C:

DEN = 0.97871 - 0.000710 T

where : DEN is density of fresh oil at T (g/mL)
T is oil temperature (°C)

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	0.986(EETD 84) 0.980(MACKAY 82A) 0.969 TO 0.981(CURL 77) 0.9941(EETD 88)	
5	0.976(MACKAY 82A) 0.9904(EETD 88)	
10	0.973(MACKAY 82A) 0.963 TO 0.975(CURL 77) 0.9867(EETD 88)	
15	0.974(EETD 84) 0.969(MACKAY 82A) 0.9830(EETD 88)	
15.6	0.9710(API 81) 0.963(YUEN 70) 0.959 TO 0.972(CURL 77)	
20	0.966(MACKAY 82A) 0.956 TO 0.970(CURL 77) 0.9788(EETD 88)	
25	0.964(MACKAY 82A) 0.9749(EETD 88)	
30	0.950 TO 0.964(CURL 77) 0.9718(EETD 88)	

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

WEATHERING
(%)TEMP
(°C)

0

0	73,500,000 (TWARDUS 80) 1,400,000 (EETD 88)
10	28,700,000 (TWARDUS 80)
15	48,000 (EETD 88)
20	5,980,000 (TWARDUS 80)
25	3,180 (MACKAY 82A)
50	545 (YUEN 70)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):WEATHERING
(%)TEMP
(°C)

0

10	>1000 (CURL 77)
20	>500 (CURL 77)
40	>130 (CURL 77)
55	90 TO 2000 (CURL 77)
60	65 TO 1000 (CURL 77)
70	65 TO 360 (CURL 77)
80	65 TO 180 (CURL 77)

NOTE: DATA OBTAINED FROM A GRAPH

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	N/M(EETD 88)
15	N/M(EETD 88)
room	27(TWARDUS 80)

5.2 OIL-SEAWATER (mN/m or dynes/cm): N/M(EETD 88)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	N/M(EETD 88)
15	N/M(EETD 88)
room	39.82(TWARDUS 80)

6.0 POUR POINT (°C): 6(MACKAY 82A)
7(TWARDUS 80)
2(FINGAS 79)
<16(CURL 77)
-1(YUEN 70)
15(EETD 88)

7.0 FLASH POINT (°C): >110(C.C.)(EETD 84)
66(OHMSTADS 81)
60(MIN, ASTM D 396)
174(O.C.)(TWARDUS 80)
80(FINGAS 79)
>66(CURL 77)
99(YUEN 70)
98(EETD 88)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME
PERCENT
-----VAPOUR
TEMPERATURE
-----LIQUID
TEMPERATURE

IBP	115 (TWARDUS 80)	
	151 (API 81)	
	78 (EETD 88)	324 (EETD 88)
5	222 (API 81)	
	126 (EETD 88)	391 (EETD 88)
10	310 (TWARDUS 80)	
	248 (API 81)	
	166 (EETD 88)	414 (EETD 88)
15	259 (API 81)	
	199 (EETD 88)	422 (EETD 88)
20	335 (TWARDUS 80)	
	267 (API 81)	
	217 (EETD 88)	427 (EETD 88)
25	272 (API 81)	
	225 (EETD 88)	428 (EETD 88)
30	345 (TWARDUS 80)	
	277 (API 81)	
	231 (EETD 88)	432 (EETD 88)
35	282 (API 81)	
	233 (EETD 88)	435 (EETD 88)
40	350 (TWARDUS 80)	
	286 (API 81)	
	234 (EETD 88)	438 (EETD 88)
45	293 (API 81)	
	235 (EETD 88)	440 (EETD 88)
50	355 (TWARDUS 80)	
	299 (API 81)	
	235 (EETD 88)	441 (EETD 88)
55	304 (API 81)	
	235 (EETD 88)	445 (EETD 88)
60	367 (TWARDUS 80)	
	312 (API 81)	
	235 (EETD 88)	448 (EETD 88)
65	318 (API 81)	
	235 (EETD 88)	449 (EETD 88)
70	370 (TWARDUS 80)	
	326 (API 81)	
75	375 (TWARDUS 80)	
	333 (API 81)	
80	344 (API 81)	
85	357 (API 81)	
90	387 (API 81)	
95	417 (API 81)	
FBP	441 (API 81)	

NOTE: (API 81) DATA FROM SIMULATED DISTILLATION METHOD
ASTM D 2887

10.0 EMULSION FORMATION TENDENCY & STABILITY:
BUNKER C FROM THE ARROW INCIDENT FORMED STABLE
EMULSIONS (YUEN 70)

10.1 EMULSION FORMATION TENDENCY:
WEATHERING
(%)

TEMP (°C)	0
0	0.1 (EETD 84) 0 (EETD 88)
15	0 (EETD 84) 0 (EETD 88)

10.2 EMULSION STABILITY:
WEATHERING
(%)

TEMP (°C)	0
0	0.2 (EETD 84) 0 (EETD 88)
15	0.1 (EETD 84) 0 (EETD 88)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	N/M (EETD 84)
15	N/M (EETD 84)

11.0 WEATHERING:

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (%)	
	0	
0	0 (EETD 85)	
15	3 (EETD 85)	

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (%)	
	0	
0	0 (EETD 85)	
15	0 (EETD 85)	

13.0 HYDROCARBON GROUP ANALYSIS:

HYDROCARBON GROUP	WT %
SATURATES	21.1 (PANCIROV 74) (ASTM D-2007) 20.98 (WATERS 82) 15 (CURL 77) 24.4 (MACKAY 82A) 21.1 (CLARK 77)
AROMATICS	34.2 (PANCIROV 74) (ASTM D-2007) 33.83 (WATERS 82) 25 (CURL 77) 54.6 (MACKAY 82A) 34.2 (CLARK 77)
POLARS	30.3 (PANCIROV 74) (ASTM D-2007) 7.39 (WATERS 82) 15 (CURL 77) 14.9 (MACKAY 82A) 30.3 (CLARK 77)
ASPHALTENES	14.4 (PANCIROV 74) (ASTM D-2007) 6.17 (MACKAY 82A) 9.28 (YUEN 70) 14.4 (CLARK 77)
NAPHTHENES	45 (CURL 77)

14.0 AQUEOUS SOLUBILITY (mg/L):

in 32 o/oo seawater @ 20°C: 6.3 (ANDERSON 74)
 in distilled water: 1.7 (MURRAY 84)
 in distilled water @ 22°C: 0.4 (SUNTIO 86)
 in freshwater: 4.45 (MACLEAN 88)
 in seawater: 2.29 (MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

48 hour EC₅₀: 0.37 (BOBRA 88)
 4.14 (MACLEAN 88)
 48 hour LC₅₀: >0.4 (BOBRA 88)
 >4.45 (MACLEAN 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

48 hour EC₅₀: >0.32 (BOBRA 88)
 >2.29 (MACLEAN 88)
 48 hour LC₅₀: >0.32 (BOBRA 88)
 >2.29 (MACLEAN 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE SPECTROSCOPY.

RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP GC ANALYSIS.

ACUTE TOXICITY OF WATER SOLUBLE FRACTIONS (PPM):

SPECIES	24 hour LC ₅₀	48 hour LC ₅₀	96 hour LC ₅₀
POLYCHAETA:			
NEANIHES ARENACEODENTATA	>6.3 (ROSSI 76)	4.6 (ROSSI 76)	3.6 (ROSSI 76)
CAPITAEIA CAPITATA	>6.3 (ROSSI 76)	1.1 (ROSSI 76)	0.9 (ROSSI 76)
CRUSTACEA:			
MYSIDOPSIS ALMYRA	6.3 (ANDERSON 74)	0.9 (ANDERSON 74)	
PALAEONETES FUGIO	3.2 (ANDERSON 74)	2.8 (ANDERSON 74)	2.6 (ANDERSON 74)
PENAEUS AZTECUS	3.8 (ANDERSON 74)	3.5 (ANDERSON 74)	1.9 (ANDERSON 74)
FISH:			
MENIDIA BERYLLINA	3.6 (ANDERSON 74)	2.7 (ANDERSON 74)	1.9 (ANDERSON 74)
FUNDULUS SIMILIS	3.8 (ANDERSON 74)	2.3 (ANDERSON 74)	1.7 (ANDERSON 74)
CYPRINODON VARIEGATUS	4.7 (ANDERSON 74)	4.4 (ANDERSON 74)	3.1 (ANDERSON 74)

COMBUSTION PRODUCTS: NO GREAT HAZARD (OHMTADS 81)

POTENTIAL FOR ACCUMULATION: NEGATIVE (OHMTADS 81)

16.0 SULPHUR (WT %): 2.40 (API 81)
 1.46 (PANCIROV 74)
 2.24 (YUEN 70)
 1.5 (EETD 88)

17.0 OTHERS:

17.1 IN-SITU COMBUSTION OF FRESH OIL:

RELATIVELY LONG IGNITION TIME (1.9 MIN)
26.4 VOL % RESIDUE (TWARDUS 80)

17.2 AUTO IGNITION POINT ($^{\circ}\text{C}$): 408(OHMTADS 81)
407(CURL 77)

17.3 BOILING POINT ($^{\circ}\text{C}$): 400(OHMTADS 81)

17.4 TOTAL ASH CONTENT (WT %): 0.08(YUEN 70)

17.5 NITROGEN CONTENT (WT %): 0.34(API 81)
0.94(PANCIROV 74)

17.6 FIRE POINT ($^{\circ}\text{C}$): >257(TWARDUS 80)
164(YUEN 70)

17.7 INITIAL BOILING POINT ($^{\circ}\text{C}$): 180 TO 500(FINGAS 79)

17.8 WAX (WT %): 55.4(MACKAY 82A)

17.9 CARBON RESIDUE (WT %): 12.00(YUEN 70)

17.10 METALS (PPM): NICKEL: 62(API 81)
89(PANCIROV 74)
35(YUEN 70)

VANADIUM: 25 TO 26(API 81)
73(PANCIROV 74)
272(YUEN 70)

17.11 COMPOSITIONAL ANALYSIS (WT %):

SATURATES:

N-ALKANES C ₁₃ ⁺	1.73
ISOALKANES	5.0
1-RING CYCLOALKANES	3.9
2-RING CYCLOALKANES	3.4
3-RING CYCLOALKANES	2.9
4-RING CYCLOALKANES	2.7
5-RING CYCLOALKANES	1.9
6-RING CYCLOALKANES	0.4

AROMATICS:

BENZENES	1.9
INDANS & TETRALINS	2.1
DINAPHTHENO BENZENES	2.0
METHYLNAPHTHALENES	2.6
ACENAPHTHENES	3.1
ACENAPHTHALENES	7.0
PHENANTHRENES	11.6
PYRENES	1.7
BENZOTHIOPHENES	1.5
DIBENZOTHIOPHENES	0.7 (CLARK 77)

1.0 TYPE: CALIFORNIA CRUDE OIL API GRAVITY 11.

2.0 API GRAVITY (15/15°C): 10.3(EETD 88)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)	
	0	
0	0.9968	(EETD 88)
5	0.9942	(EETD 88)
10	0.9915	(EETD 88)
15	0.9882	(EETD 88)
20	0.9852	(EETD 88)
25	0.9824	(EETD 88)
30	0.9796	(EETD 88)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)	
	0	
0	220,000	(EETD 88)
15	34,000	(EETD 88)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	0
0	N/M(EETD 88)
15	37.0(EETD 88)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	0
0	N/M(EETD 88)
15	N/M(EETD 88)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	0
0	N/M(EETD 88)
15	N/M(EETD 88)

6.0 POUR POINT (°C): 0(EETD 88)

7.0 FLASH POINT (°C): 28(C.C)(EETD 88)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

Sample contained approximately 6% water, distillation could not be properly performed.(EETD 88)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

WEATHERING

TEMP (%)

(°C)

0

0 0(EETD 88)

15 0(EETD 88)

10.2 EMULSION STABILITY:

WEATHERING

TEMP (%)

(°C)

0

0 0(EETD 88)

15 0(EETD 88)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

WEATHERING

TEMP (%)

(°C)

0

0 N/A(EETD 88)

15 N/A(EETD 88)

11.0 WEATHERING:

12.0 DISPERSIBILITY: N/M(EETD 88)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	13.7
AROMATICS	29.8
POLARS	31.4
ASPHALTENES	24.8 (MACKAY 88)

14.0 AQUEOUS SOLUBILITY (mg/L):

in double distilled water @ 22°C:	11.33 (MACKAY 88)
in salt water @ 22°C:	9.74 (MACKAY 88)

15.0 TOXICITY:

16.0 SULPHUR (WT %): 3.3(EETD 88)

17.0 OTHERS:

1.0 TYPE: CALIFORNIA CRUDE OIL API GRAVITY 15.

2.0 API GRAVITY (15/15°C): 13.2(EETD 88)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
0	0.9907(EETD 88)
5	0.9832(EETD 88)
10	0.9802(EETD 88)
15	0.9770(EETD 88)
20	0.9735(EETD 88)
25	0.9702(EETD 88)
30	0.9672(EETD 88)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	31,000(EETD 88)
15	6,400(EETD 88)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	
---	--

0	N/M(EETD 88)
---	--------------

15	33.6(EETD 88)
----	---------------

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	
---	--

0	N/M(EETD 88)
---	--------------

15	N/M(EETD 88)
----	--------------

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	
---	--

0	N/M(EETD 88)
---	--------------

15	N/M(EETD 88)
----	--------------

6.0 POUR POINT (°C): -9(EETD 88)

7.0 FLASH POINT (°C): 12(C.C)(EETD 88)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	159	45
5	244	113
10	283	135
15	330	158
20	369	185
25	387	203
30	399	214
35	406	224
40	411	232
45	415	237
50	420	243
	(EETD 88)	(EETD 88)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	0 (EETD 88)
15	0 (EETD 88)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	0 (EETD 88)
15	0 (EETD 88)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	N/A (EETD 88)
15	N/A (EETD 88)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 11,749.3 \theta \exp(6.3 - 4,602.8/TK)/TK)}{(11,749.3 / TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
 θ is evaporative exposure
exp is exponential base e
TK is environmental temperature
(Kevin, K = °C + 273)
(EETD 88)

12.0 DISPERSIBILITY: N/M(EETD 88)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	13.7
AROMATICS	36.4
POLARS	24.1
ASPHALTENES	25.8(MACKAY 88)

14.0 AQUEOUS SOLUBILITY (mg/L):

in double distilled water @ 22°C:	25.7(MACKAY 88)
in salt water @ 22°C:	14.7(MACKAY 88)

15.0 TOXICITY:

16.0 SULPHUR (WT %): 5.5(EETD 88)

17.0 OTHERS:

1.0 TYPE: COHASSET A-52 CRUDE OIL, OFFSHORE NOVA SCOTIA.
DATA FOR EQUILIBRIUM LIQUID OF SEPARATOR FLASH TEST.

2.0 API GRAVITY (15.5/15.5°C): 50.1 (PETRO-CAN 87)

3.0 DENSITY (g/mL):

TEMP (°C)		WEATHERING (%)
0		
15	0.7789 (PETRO-CAN 87)	

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 RELATIVE MOLECULAR MASS: 148.2 (PETRO-CAN 87)

17.2 COMPOSITIONAL ANALYSIS:

COMPONENT	MOLE FRACTION	MASS FRACTION	VOLUME FRACTION
N ₂	0.0000	0.0000	0.0000
CO ₂	0.0000	0.0000	0.0000
H ₂ S	0.0000	0.0000	0.0000
C ₁	0.0032	0.0003	0.0009
C ₂	0.0007	0.0001	0.0003
C ₃	0.0020	0.0006	0.0009
iC ₄	0.0023	0.0009	0.0012
C ₄	0.0032	0.0013	0.0017
iC ₅	0.0090	0.0044	0.0055
C ₅	0.0108	0.0053	0.0065
C ₆	0.0589	0.0337	
C ₇	0.0969	0.0646	
C ₈	0.1288	0.0979	
C ₉	0.0819	0.0699	
C ₁₀	0.0894	0.0846	
C ₁₁	0.0722	0.0750	
C ₁₂	0.0583	0.0661	
C ₁₃	0.0529	0.0649	
C ₁₄	0.0451	0.0595	
C ₁₅	0.0400	0.0565	
C ₁₆	0.0285	0.0430	
C ₁₇	0.0241	0.0385	
C ₁₈	0.0167	0.0282	
C ₁₉	0.0132	0.0235	
C ₂₀	0.0102	0.0191	
C ₂₁	0.0086	0.0170	
C ₂₂	0.0070	0.0144	
C ₂₃	0.0049	0.0106	
C ₂₄	0.0040	0.0091	
C ₂₅	0.0032	0.0076	
C ₂₆	0.0024	0.0059	
C ₂₇	0.0022	0.0056	
C ₂₈	0.0014	0.0037	
C ₂₉	0.0010	0.0028	
C ₃₀₊	0.0031	0.0102	
AROMATICS:			
C ₆ H ₆	0.0014	0.0007	
C ₇ H ₈	0.0071	0.0044	
C ₈ H ₁₀	0.0234	0.0166	
C ₈ H ₁₀	0.0102	0.0072	
C ₉ H ₁₂	0.0090	0.0072	
NAPHTHENES:			
C ₅ H ₁₀	0.0037	0.0017	
C ₆ H ₁₂	0.0073	0.0041	
C ₆ H ₁₂	0.0054	0.0030	
C ₇ H ₁₄	0.0464	0.0303	(PETRO-CAN 87)

1.0 TYPE: COLD LAKE BITUMEN FROM ESSO RESOURCES CANADA.

2.0 API GRAVITY: 9.8(EETD 88)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
0	

0 1.0075(EETD 88)

5 1.0049(EETD 88)

10 1.0023(EETD 88)

15 1.0002(EETD 88)

20 0.9968(EETD 88)

25 0.9943(EETD 88)

30 0.9916(EETD 88)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	

0 >3,000,000(EETD 88)

15 235,000(EETD 88)

5.0 INTERFACIAL TENSIONS: N/M(EETD 88)

6.0 POUR POINT (°C): 9(EETD 88)

7.0 FLASH POINT (°C): 81(EETD 88)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

Distillation showed that bitumen contained approximately 10% by volume water. No other fractions were collected below a liquid temperature of 335 °C. (EETD 88)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	0.0(EETD 88)	
15	0.0(EETD 88)	

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	0.0(EETD 88)	
15	0.0(EETD 88)	

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	N/M(EETD 88)	
15	N/M(EETD 88)	

11.0 WEATHERING:

12.0 DISPERSIBILITY: N/M(EETD 88)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	16.6
AROMATICS	39.2
ASPHALTENES	19.3
POLARS	24.9(EETD 88)

14.0 AQUEOUS SOLUBILITY (mg/L):

in double distilled water @ 22 °C: 0.26(MACKAY 88)
in seawater water @ 22 °C: 0.13(MACKAY 88)

15.0 TOXICITY:

16.0 SULPHUR CONTENT (WT. %): 6.9(EETD 88)

17.0 OTHERS:

1.0 TYPE: COLD LAKE CRUDE OIL, ALBERTA.

2.0 API GRAVITY:

3.0 DENSITY (g/mL): 0.9031(AALUND 83A)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 15 °C: 70.7(AALUND 83A)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -60(AALUND 83A)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 2.91(AALUND 83A)

17.0 OTHERS:

17.1 NITROGEN (WT %): 0.29(AALUND 83A)

17.2 YIELD ON CRUDE:

	RANGE, °C	VOL %
C ₅ & lighter		7.43
NAPHTHA	20 - 175	30.0
DISTILLATE	175 - 295	10.5
GAS OIL	343 - 517	18.7
RESIDIUM	343 +	51.6
ASPHALT	405 +	47.8
ASPHALT	470 +	37.7
(AALUND 83A)		

1.0 TYPE: COLD LAKE DILBIT FROM ESSO RESOURCES CANADA.
BLEND OF COLD LAKE BITUMEN AND DILUENT.

2.0 API GRAVITY (15/15°C): 22.6(EETD 88)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	0.9273(EETD 88)	
15	0.9172(EETD 88)	

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	425(EETD 88)	
15	150(EETD 88)	

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	---------------------

0	
---	--

0	29.2 (EETD 88)
---	----------------

15	27.1 (EETD 88)
----	----------------

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	---------------------

0	
---	--

0	28.1 (EETD 88)
---	----------------

15	16.3 (EETD 88)
----	----------------

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	---------------------

0	
---	--

0	28.3 (EETD 88)
---	----------------

15	21.7 (EETD 88)
----	----------------

6.0 POUR POINT (°C): -45 (EETD 88)

7.0 FLASH POINT (°C): <-35 (EETD 88)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	78	29
5	127	41
10	189	60
15	276	72
20	353	145
25	391	198
30	409	222
35	419	234
40	426	249
45	435	260
50	439	262
55	443	263
60	445 (EETD 88)	263 (EETD 88)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

WEATHERING
(%)

TEMP
(°C)

0

0

1.0 (EETD 88)

15

1.0 (EETD 88)

10.2 EMULSION STABILITY:

WEATHERING
(%)

TEMP
(°C)

0

0

1.0 (EETD 88)

15

1.0 (EETD 88)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

WEATHERING
(%)

TEMP
(°C)

0

0

65 (EETD 88)

15

71 (EETD 88)

11.0 WEATHERING:

$$F_V = \frac{\ln(1 + 14,652.47 \theta \exp (6.3 - 3,424.24/T_K)/T_K)}{(14,652.47/T_K)}$$

where: F_V is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 T_K is environmental temperature
 (Kelvin, $K = ^\circ C + 273$) (EETD 88)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
 OIL TO DISPERSANT RATIO: 20 TO 1.

TEMP ($^{\circ}C$)	WEATHERING (%)
0	0
0	64 (EETD 88)
15	69 (EETD 88)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP ($^{\circ}C$)	WEATHERING (%)
0	0
0	0 (EETD 88)
15	0 (EETD 88)

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY (mg/L):
 in distilled water @ 25 $^{\circ}C$: 28.2 (EETD 88)

15.0 TOXICITY:

16.0 SULPHUR (WT. %): 4.72 (EETD 88)

17.0 OTHERS:

1.0 TYPE: COLD LAKE DILUENT FROM ESSO RESOURCES CANADA.
DILUENT USED IN COLD LAKE DILBIT.

2.0 API GRAVITY (15/15°C): 69.3(EETD 88)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
0	
0	0.7162(EETD 88)
15	0.7040(EETD 88)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	
0	0.66(EETD 88)
15	0.62(EETD 88)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	20.0(EETD 88)
15	19.9(EETD 88)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	7.5(EETD 88)
15	6.8(EETD 88)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	8.3 (EETD 88)
15	8.3 (EETD 88)

6.0 POUR POINT (°C): <-75 (EETD 88)

7.0 FLASH POINT (°C): <-35 (EETD 88)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	47	23
5	55	42
10	60	45
15	65	48
20	70	49
25	77	49
30	85	49
35	93	52
40	103	56
45	113	68
50	121	73
55	131	77
60	144	89
65	162	97
70	190 (EETD 88)	101 (EETD 88)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
0	0

0	0.0(EETD 88)
---	--------------

15	0.0(EETD 88)
----	--------------

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
0	0

0	0.0(EETD 88)
---	--------------

15	0.0(EETD 88)
----	--------------

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	0

0	N/M(EETD 88)
---	--------------

15	N/M(EETD 88)
----	--------------

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 1,848.34 \theta \exp(6.3 - 3,193.93/T_K)/T_K)}{(1,848.34/T_K)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 T_K is environmental temperature
 (Kelvin, $K = ^\circ C + 273$) (EETD 88)

12.0 DISPERSIBILITY: N/M(EETD 88)

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY (mg/L):
 in distilled water @ 25 °C: 57.9(EETD 88)

15.0 TOXICITY:

16.0 SULPHUR (WT. %): 0.25 (EETD 88)

17.0 OTHERS:

- 1.0 TYPE: COOK INLET CRUDE OIL. ALASKA.
- 2.0 API GRAVITY:
- 3.0 DENSITY:
- 4.0 VISCOSITY:
- 5.0 INTERFACIAL TENSIONS:
- 6.0 POUR POINT:
- 7.0 FLASH POINT:
- 8.0 VAPOUR PRESSURE:
- 9.0 DISTILLATION DATA:
- 10.0 EMULSION FORMATION TENDENCY & STABILITY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:
- 13.0 HYDROCARBON GROUP ANALYSIS:
- 14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION:

SPECIES	96 hour LC ₅₀ (mg/L of aromatics)

FISH:	
CLUPEA PALLASI	1.22
SALVELINUS MALMA	1.55
ONCORHYNCHUS GORBUSCHA	1.69
THERAGRA CHALCOGRAMMUS	1.73
AULORHYNCHUS FLAVIDUS	2.55
MYOXOCEPHALUS POLYACANTHCEPHALUS	3.96
PLATICHTHYS STELLATUS	>5.34
PHOLIS LAETA	>11.72
ANOPLARCHUS PURPURESCENS	>11.72
CRUSTACEANS:	
CRANGON ALASKENSIS	0.87
PANDALUS GONIURUS	1.79
EUALUS SUCKLEYI	1.86
PANDALUS BOREALIS	4.94
PARALITHODES CAMTSCHATICA	3.69
HEMIGRAPSIS NUDUS	8.45
PAGURUS HIRSUTICULUS	>10.58
ORCHOMENE PINGUIS	>7.98
ACANTHOMYSIS PSEUDOMACROPSIS	>9.02
ECHINODERMS:	
CUCUMARIA VEGA	>6.84
STRONGYLOCENTROTUS DROBACHIENSIS	>10.58
LEPTASTERIAS HEXACTIS	>10.58
EUPENTACTA QUINQUESIMITA	>12.29
MOLLUSKS:	
CHLAMYS HERICUS	3.94
MYTILUS EDULIS	>8.97
PROTOTHACA STAMINEA	>6.84
COLLISELLA SCUTUM	8.18
NOTOACMAECA PELTA	>8.46
KATHARINA TUNICATA	>8.46
TONICELLA LINEATA	>8.46
MOPALIA CILLIATA	>8.46
MARGARITES PUPILLUS	>8.46
LITTORINA SITKANA	>8.46
THAIS LIMA	>8.46
COLUS HALLI	>8.46
NEPTUNEA LYRATA	>10.58
ANNELIDS:	
NEREIS VEXILLOSA	>10.58
HARMOTHOE IMBRICATA	>10.58
NEMERTEANS:	
PARANEMERTES PEREGRINA	>10.58
LINEUS VEGETUS	>10.58 (RICE 79)

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: AUTOMOTIVE DIESEL FUEL OIL.

ALSO SEE FUEL OIL NO.2.

DATA FROM REFERENCE (EETD 85) ARE BASED ON DIESEL
SAMPLE PURCHASED FROM A SERVICE STATION IN THE SUMMER
OF 1984.

GRADE 1-D: STRAIGHT-RUN FRACTIONS INCLUDING KEROSENES TO
INTERMEDIATE DISTILLATES FROM PARAFFINIC CRUDE OR
TREATED FRACTIONS FROM MIXED-BASE CRUDES. USED FOR
MOBILE SERVICE SUCH AS TRUCKS, RAILROAD AND
SUBMARINES.

GRADE 2-D: SIMILAR TO GRADE 1-D BUT WITH LOWER VOLATILITY.
USED FOR INDUSTRIAL AND HEAVY MOBILE SERVICE.

GRADE 4-D: RESIDUAL FUEL OILS BLENDED WITH MORE VISCOUS
DISTILLATES. USED FOR LARGER STATIONARY
INSTALLATIONS. (ASTM D 975)

2.0 API GRAVITY (15/15°C): 39.4 (EETD 84)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	0.838 (EETD 84)	
15	0.827 (EETD 84)	

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	3.9 (EETD 85)	
15	2.7 (EETD 85)	

4.2 KINEMATIC VISCOSITY (mm²/s):

@ 40°C: grade 1-D: 1.3 TO 2.4

grade 2-D: 1.9 TO 4.1

grade 4-D: 5.5 TO 24.0 (ASTM D 975)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	---------------------

0	27.7 (EETD 84)
---	----------------

15	26.0 (EETD 84)
----	----------------

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	---------------------

0	28.2 (EETD 85)
---	----------------

15	28.0 (EETD 85)
----	----------------

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	---------------------

0	30.1 (EETD 85)
---	----------------

15	29.4 (EETD 85)
----	----------------

6.0 POUR POINT (°C): -20 (FINGAS 79)
-30 (EETD 86)

7.0 FLASH POINT (°C): 55 (FINGAS 79)
grade 1-D: minimum, 38 (ASTM D 975)
grade 2-D: minimum, 52 (ASTM D 975)
grade 4-D: minimum, 55 (ASTM D 975)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
90	grade 1-D: 288, max grade 2-D: 282-338

(ASTM D 975)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
--------------	--------------------

0	0
---	---

0	0 (EETD 85)
---	-------------

15	0 (EETD 85)
----	-------------

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
--------------	--------------------

0	0
---	---

0	0 (EETD 85)
---	-------------

15	0 (EETD 85)
----	-------------

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
--------------	--------------------

0	0
---	---

0	N/M(EETD 85)
---	--------------

15	N/M(EETD 85)
----	--------------

11.0 WEATHERING:

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO: 20 TO 1.

TEMP (°C)	WEATHERING (%)
0	92 (EETD 85)
15	94 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (%)
0	7 (EETD 85)
15	5 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22°C:	2.8 (SUNTIO 86)
Gulf P20 diesel in distilled water:	2.3 (MURRAY 84)
Gulf P40 diesel in distilled water:	8.3 (MURRAY 84)
in fresh water:	39.1 (MACLEAN 88)
in seawater:	60.4 (MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

48 hour EC50: 4.07(MACLEAN 88)

0.29(BOBRA 88)

48 hour LC50: 7.16(MACLEAN 88)

0.57(BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

48 hour EC50: 21.7(MACLEAN 88)

0.80(BOBRA 88)

48 hour LC50: 23.7(MACLEAN 88)

0.88(BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 83) OBTAINED BY FLUORESCENCE SPECTROSCOPY.

RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP GC ANALYSIS.

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO LARVAL RAINBOW TROUT:

48 hour LC₅₀ (closed container): 2.43(LOCKHART 87)48 hour LC₅₀ (open container): 2.52(LOCKHART 87)

16.0 SULPHUR (WT%): 0.10(EETD 86)

winter diesel: 0.16(EETD 86)

grade 1-D: maximum, 0.50(ASTM D 975)

grade 2-D: maximum, 0.50(ASTM D 975)

grade 4-D: maximum, 2.0(ASTM D 975)

17.0 OTHERS:

17.1 CLOUD POINT (°C):

winter diesel grade I: -23(TSANG 86)

winter diesel grade II: -32(TSANG 86)

17.2 INITIAL BOILING POINT (°C): 180 TO 360(FINGAS 79)

1.0 TYPE: EKOFISK CRUDE OIL, NORWAY NORTH SEA.
PHILLIPS PETROLEUM.

2.0 API GRAVITY: 35.6(HMSO 76)
43.4(AALUND 83D)

3.0 DENSITY (g/mL):
@ 15 °C: 0.847(HMSO 76)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 50 °C: 4.25(HMSO 76)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -5(HMSO 76)
-12(AALUND 83D)

7.0 FLASH POINT:

8.0 REID VAPOUR PRESSURE (kPa): 34.5(AALUND 83D)

9.0 DISTILLATION DATA:

WEIGHT PERCENT	TEMP (°C)
7	5 TO 100(HMSO 76), (CORM 78)
11.1	100 TO 160(HMSO 76), (CORM 78)
15.1	160 TO 250(HMSO 76), (CORM 78)
19	250 TO 350(HMSO 76), (CORM 78)
47.8	>350(HMSO 76), (CORM 78)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:
ASPHALTENES 0.03(CORM 78)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.18(HMSO 76)
0.14(AALUND 83D)

17.0 OTHERS:

17.1 WAX (WT %): 6.5(HMSO 76)

17.2 YIELD ON CRUDE:

	<u>RANGE, °C</u>	<u>VOL %</u>
C ₁ - C ₅		6.43
GASOLINE	IBP - 80	11.9
NAPHTHA	80 - 150	20.2
KEROSINE	150 - 204	10.6
GAS OIL	204 - 350	23.4
GAS OIL	350 - 375	37.3
HEAVY GAS OIL	375 - 525	13.2
RESIDUE	525 +	25.2

(AALUND 83D)

1.0 TYPE: ELECTRICAL INSULATING OIL, VOLTESSO 35.
SAMPLE OBTAINED FROM ONTARIO HYDRO.
NAPHTHENIC-BASED OIL FOR USE IN ELECTRICAL
TRANSFORMERS, CIRCUIT BREAKERS AND OTHER KINDS
OF ELECTRICAL EQUIPMENT.

2.0 API GRAVITY(15/15°C): 31.6(ESSO 84)
28.8(EETD 85)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
0	0.8922(EETD 85)
15	0.8818(EETD 85) 0.8666(ESSO 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	37.8(EETD 85)
15	18.8(EETD 85)

4.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP ($^{\circ}\text{C}$)	WEATHERING (%)
0	
-45	5000(ESSO 84)
-40	2000(ESSO 84)
-30	600(ESSO 84)
0	42.4(EETD 85) 50(ESSO 84)
15	21.3(EETD 85)
40	8.0(ESSO 84)
100	2.2(ESSO 84)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP ($^{\circ}\text{C}$)	WEATHERING (%)
0	
0	30.2(EETD 85)
15	29.6(EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP ($^{\circ}\text{C}$)	WEATHERING (%)
0	
0	17.7(EETD 85)
15	14.2(EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP ($^{\circ}\text{C}$)	WEATHERING (%)
0	
0	20.2(EETD 85)
15	19.8(EETD 85)

6.0 POUR POINT (°C): <-34 (EETD 85)
-51 (ESSO 84)

7.0 FLASH POINT (°C): >110 (C.C.) (EETD 85)
151 (COC) (ESSO 84)

8.0 VAPOUR PRESSURE: @ 40 °C, 3 microns (ESSO 84)
@ 100 °C, 350 microns (ESSO 84)
@ 150 °C, 5mm (ESSO 84)
@ 200 °C, 45mm (ESSO 84)

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMP (°C)
10	278
20	297
50	336
90	390
95	404 (ESSO 84)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
0	0 (EETD 85)
15	0 (EETD 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
0	0 (EETD 85)
15	0 (EETD 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	N/A(EETD 85)
15	N/A(EETD 85)

11.0 WEATHERING: Insulating oil did not weather when stripped by air at room temperature.
(EETD 85)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (%)
0	72(EETD 85)
15	94(EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (%)
0	21(EETD 85)
15	21(EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	78
AROMATICS & POLARS	22

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.15(ESSO 84)
0.08(EETD 86)

17.0 OTHERS:**17.1 WATER SATURATION LEVELS (PPM):**

@ 0 °C, 16
@ 10 °C, 27
@ 15 °C, 35
@ 20 °C, 45
@ 25 °C, 56(ESSO 84)

17.2 ANILINE POINT (°C): 81(ESSO 84)

17.3 FIRE POINT (°C): 177(COC)(ESSO 84)

17.4 AIR SOLUBILITY (VOL %): @ 15.6 °C: 9.8(ESSO 84)

17.5 TOTAL ACID No.: NIL(ESSO 84)

17.6 OCCUPATIONAL EXPOSURE LIMIT (mg/m₃):
FOR OIL MISTS: 5(ACGIH 83)

17.7 COLOR: 0.5(ESSO 84)

1.0 TYPE: USED ELECTRICAL INSULATING OIL, VOLTESSO 35.
SAMPLE OBTAINED FROM ONTARIO HYDRO.
NAPHTHENIC-BASED OIL USED IN ELECTRICAL
TRANSFORMERS, CIRCUIT BREAKERS AND OTHER
KINDS OF ELECTRICAL EQUIPMENT.

2.0 API GRAVITY (15/15°C): 31.5(EETD 85)

3.0 DENSITY (g/mL):

TEMP (°C)	0	WEATHERING (%)
0	0.8779(EETD 85)	
15	0.8673(EETD 85)	

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	0	WEATHERING (%)
0	35.8(EETD 85)	
15	18.1(EETD 85)	

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	0	WEATHERING (%)
0	40.8(EETD 85)	
15	20.9(EETD 85)	

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	30.6 (EETD 85)
15	29.5 (EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	23.9 (EETD 85)
15	16.7 (EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	24.1 (EETD 85)
15	23.6 (EETD 85)

6.0 POUR POINT (°C): <-34 (EETD 85)

7.0 FLASH POINT (°C): >110 (C.C.) (EETD 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
--------------	---------------------

0	
---	--

0	0 (EETD 85)
---	-------------

15	0 (EETD 85)
----	-------------

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
--------------	---------------------

0	
---	--

0	0 (EETD 85)
---	-------------

15	0 (EETD 85)
----	-------------

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
--------------	---------------------

0	
---	--

0	N/A (EETD 85)
---	---------------

15	N/A (EETD 85)
----	---------------

11.0 WEATHERING: Note: Insulating oil did not weather when stripped by air at room temperature. (EETD 85)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (%)
0	72 (EETD 85)
15	95 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (%)
0	20 (EETD 85)
15	21 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.10 (EETD 86)

17.0 OTHERS:

1.0 TYPE: NEW "LUBE 27" GRADE LUBRICATING OIL.
SAMPLE OBTAINED FROM ONTARIO HYDRO. LUBE 27 IS
USED IN HYDRAULIC TURBINE AND GOVERNOR SYSTEMS
OF HYDRAULIC GENERATING STATIONS.

2.0 API GRAVITY (15/15°C): 30.5(EETD 85)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
0	0.8820(EETD 85)
15	0.8727(EETD 85)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	350(EETD 85)
15	144(EETD 85)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (%)
0	396.8(EETD 85)
15	165(EETD 85)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	32.8 (EETD 85)
15	31.2 (EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	19.0 (EETD 85)
15	13.6 (EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	22.3 (EETD 85)
15	19.4 (EETD 85)

6.0 POUR POINT (°C): -24 (EETD 85)

7.0 FLASH POINT (°C): >110 (C.C.) (EETD 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
0	0 (EETD 85)
15	0 (EETD 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
0	0 (EETD 85)
15	0 (EETD 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	N/A (EETD 85)
15	N/A (EETD 85)

11.0 WEATHERING: Note: Lube 27 did not weather when
stripped by air at room temperature.
(EETD 85)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED)
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (%)	
	0	
0	49 (EETD 85)	
15	27 (EETD 85)	

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (%)	
	0	
0	4 (EETD 85)	
15	13 (EETD 85)	

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR: 0.43 (EETD 86)

17.0 OTHERS:

1.0 TYPE: USED "LUBE 27" GRADE LUBRICATING OIL.
SAMPLE OBTAINED FROM ONTARIO HYDRO. LUBE 27 IS
USED IN HYDRAULIC TURBINE AND GOVERNOR SYSTEMS
OF HYDRAULIC GENERATING STATIONS.

2.0 API GRAVITY (15/15°C): 30.3(EETD 85)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (VOL %)
0	
0	0.8834(EETD 85)
15	0.8737(EETD 85)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)
0	
0	359(EETD 85)
15	154(EETD 85)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (VOL %)
0	
0	406(EETD 85)
15	176(EETD 85)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)
0	31.9 (EETD 85)
15	31.0 (EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)
0	21.8 (EETD 85)
15	11.4 (EETD85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)
0	24.4 (EETD 85)
15	22.0 (EETD 85)

6.0 POUR POINT (°C): -27 (EETD 85)

7.0 FLASH POINT (°C): >110 (C.C.) (EETD 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
0	0 (EETD 85)
15	0 (EETD 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
0	0 (EETD 85)
15	0 (EETD 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	N/A (EETD 85)
15	N/A (EETD 85)

11.0 WEATHERING: Note: Lube 27 did not weather when
stripped by air at room temperature.
(EETD 85)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (%)
0	52 (EETD 85)
15	29 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (%)
0	3 (EETD 85)
15	13 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR: 0.43 (EETD 86)

17.0 OTHERS:

1.0 TYPE: FEDERATED CRUDE OIL.

2.0 API GRAVITY (15/15°C): 39.7(EETD 86)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (VOL %)		
	0	14.3	31.4
0	0.8378(EETD 86)	0.8661(EETD 86)	0.8860(EETD 86)
15	0.8258(EETD 86)	0.8537(EETD 86)	0.8742(EETD 86)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)		
	0	14.3	31.4
0	10.0(EETD 86)	207(EETD 86)	40,000(EETD 86)
15	4.5(EETD 86)	10.7(EETD 86)	140.7(EETD 86)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (VOL %)		
	0	14.3	31.4
0	15.8(EETD 86)	239(EETD 86)	N/M(EETD 86)
15	5.2(EETD 86)	12.6(EETD 86)	161(EETD 86)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
0	14.3	31.4	
0	26.9 (EETD 86)	28.3 (EETD 86)	N/M (EETD 86)
15	25.7 (EETD 86)	28.0 (EETD 86)	29.5 (EETD 86)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
0	14.3	31.4	
0	22.4 (EETD 86)	23.1 (EETD 86)	N/M (EETD 86)
15	22.2 (EETD 86)	23.0 (EETD 86)	24.1 (EETD 86)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
0	14.3	31.4	
0	23.6 (EETD 86)	25.9 (EETD 86)	N/M (EETD 86)
15	23.1 (EETD 86)	24.4 (EETD 86)	24.6 (EETD 86)

6.0 POUR POINT (°C):

WEATHERING (VOL %)	POUR POINT (°C)
0	-9 (EETD 86)
14.3	3 (EETD 86)
31.4	9 (EETD 86)

7.0 FLASH POINT (°C): -26 (C.C) (EETD 86)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	105	28
5	145	89
10	165	108
15	184	118
20	203	120
25	225	121
30	249	124
35	274	132
40	299	144
45	324	159
50	350	176
55	373	195
60	396	215
65	414	245
70	433	272
75	450	304
80	464	323
85	477	338
90	484	345
	(EETD 86)	(EETD 86)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (VOL %)		
	0	14.3	31.4
0	1.0(EETD 86)	1.0(EETD 86)	1.0(EETD 86)
15	0.3(EETD 86)	1.0(EETD 86)	1.0(EETD 86)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (VOL %)		
	0	14.3	31.4
0	1.0(EETD 86)	1.0(EETD 86)	1.0(EETD 86)
15	0.07(EETD 86)	0.5(EETD 86)	1.0(EETD 86)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	14.3	31.4
0	89.3(EETD 86)	88.5(EETD 86)	88.3(EETD 86)
15	99.0(EETD 86)	94.0(EETD 86)	89.8(EETD 86)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 4570 \theta \exp(6.3 - 4024 / TK) / TK)}{(4570 / TK)}$$

where: F_v is fraction of oil weathered by volume

$\ln$ is natural log

θ is evaporation exposure

$\exp$ is exponential base e

TK is environmental temperature

(Kelvin, $K = ^\circ C + 273$)

(EETD 86)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	14.3	31.4
0	49.0(EETD 86)	9.2(EETD 86)	0(EETD 86)
15	74.7(EETD 86)	67.9(EETD 86)	67.8(EETD 86)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	14.3	31.4
0	0(EETD 86)	0(EETD 86)	0(EETD 86)
15	1.9(EETD 86)	3.2(EETD 86)	2.0(EETD 86)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES 87.1
AROMATICS 10.9
POLARS 1.3
ASPHALTENES 0.7 (EETD 86)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

WEATHERING (VOL %)	SULPHUR CONTENT (WT %)
0	0.21(EETD 86)
14.3	0.16(EETD 86)
31.4	0.35(EETD 86)

17.0 OTHERS:

1.0 TYPE: FEDERATED LIGHT AND MEDIUM CRUDE OIL, ALBERTA.

2.0 API GRAVITY: 39.7(AALUND 83A)

3.0 DENSITY (g/mL):
@ 21 °C: 0.8258(AALUND 83A)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 40 °C: 42.42(AALUND 83A)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -10(AALUND 83A)

7.0 FLASH POINT:

8.0 REID VAPOUR PRESSURE (kPa): 31.0(AALUND 83A)

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (PPM): 2010(AALUND 83A)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 1.46(AALUND 83A)

17.2 METALS (PPM): NICKEL: 0.07(AALUND 83A)
VANADIUM: 0.00(AALUND 83A)

17.3 NITROGEN (WT %): 0.11(AALUND 83A)

17.4 WAX (WT %): 9.12(AALUND 83A)

17.5 YIELD ON CRUDE:

	RANGE, °C	VOL %
	-----	-----
NAPHTHA	C5 - 190	30.90
KEROSINE	190 - 277	18.25
DISTILLATE	277 - 343	13.73
GAS OIL	343 - 565	28.29
RESIDUE	565 +	8.83
	-----	-----
		(AALUND 83A)

1.0 TYPE: FORTIES CRUDE OIL. BRITISH PETROLEUM, U.K., NORTH SEA.

2.0 API GRAVITY: 37.35(HMSO 76)
37.4(LYNCH 81)
36.6(AALUND 83D)

3.0 DENSITY (g/mL):
@ 15 °C: 0.838(HMSO 76)
@ 16 °C: 0.8373(LYNCH 81)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 10 °C: 9.6(AALUND 83D)
@ 21.1 °C: 6.81(AALUND 83D)
@ 50 °C: 3.7(LYNCH 81)
@ 50 °C: 3.7(HMSO 76)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -1(HMSO 76)
-3(LYNCH 81)
-3(AALUND 83D)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

WEIGHT PERCENT	TEMP (°C)
7.9	5 TO 100(HMSO 76) (LYNCH 81)
11.7	100 TO 160(HMSO 76) (LYNCH 81)
12.5	160 TO 250(HMSO 76) (LYNCH 81)
21.9	250 TO 350(HMSO 76) (LYNCH 81)
46.0	>350(HMSO 76) (LYNCH 81)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS(WT %):
ASPHALTENES 0.2(IP METHOD 143/57) (LYNCH 81)
0.2(AALUND 83D)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.29(HMSO 76)
0.30(AALUND 83D)

17.0 OTHERS:

17.1 WAX (WT %): 9(HMSO 76)
9(LYNCH 81)
7.0(AALUND 83D)

17.2 CARBON RESIDUE (WT %): 2.2(AALUND 83D)

17.3 METALS (PPM WT): NICKEL: 2(AALUND 83D)
VANADIUM: 3(AALUND 83D)

17.4 YIELD ON CRUDE:

	RANGE, °C	VOL %
	-----	-----
	C ₁ - C ₄	2.74
GASOLINE	C ₅ - 95	9.23
NAPHTHA	95 - 149	20.02
KEROSINE	149 - 232	14.50
GAS OIL	232 - 342	20.92
RESIDUE	342 +	40.96
FCC FEED	342 - 509	20.38
	-----	-----

(AALUND 83D)

1.0 TYPE: FUEL OIL NO.1, KEROSENE.

2.0 API GRAVITY (15/15°C): 39.4 TO 34.8 (CURL 77)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
0	0
0	0.837 TO 0.847 (CURL 77)
15	0.827 TO 0.850 (CURL 77) 0.8495 (MAX, ASTM D 396)
20	0.823 TO 0.847 (CURL 77)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (%)
0	0
0	3.1 TO 5.0 (CURL 77)
15	2.1 TO 3.5 (CURL 77)
20	1.9 TO 3.3 (CURL 77)
38	1.4 TO 2.2 (ASTM D 396)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -18 (CURL 77)
-18 (MAX, ASTM D 396)

7.0 FLASH POINT (°C): 38 TO 74 (CURL 77)
38 (MIN, ASTM D 396)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	TEMPERATURE (°C)
10	215 (MAX, ASTM D 396)
90	288 (MAX, ASTM D 396)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

PARAFFINS	35(CURL 77)
NAPHTHENES	60(CURL 77)
AROMATICS	15(CURL 77)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO LARVAL RAINBOW TROUT (freshwater):

48 hour LC₅₀ (closed container): 1.63 mg/L(LOCKHART 87)

48 hour LC₅₀ (open container): 1.60 mg/L(LOCKHART 87)

ACUTE TOXICITY OF OIL-IN-WATER EMULSION (freshwater/flowthrough apparatus):

96 hour LC₅₀, fathead minnow: 56.7 uL/L(HEDTKE 82)

96 hour LC₅₀, frog larvae: 45.8 uL/L(HEDTKE 82)

16.0 SULPHUR (WT %): 0.5(MAX, ASTM D 396)

17.0 OTHERS:

17.1 AUTO-IGNITION TEMPERATURE (°C): 229(CURL 77)

17.2 EXPLOSION LIMITS OF VAPOUR IN AIR:

UPPER: 5.0%(CURL 77)

LOWER: 0.7%(CURL 77)

17.3 BOILING RANGE (°C): 174 TO 266(CURL 77)

1.0 TYPE: FUEL OIL NO.1 (JET FUEL, J.P.-1).

2.0 API GRAVITY:

3.0 DENSITY:

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT ($^{\circ}\text{C}$): 35 TO 63(CURL 77)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 AUTO-IGNITION TEMPERATURE ($^{\circ}\text{C}$): 229(CURL 77)

- 1.0 TYPE: FUEL OIL NO.1 (JET FUEL, J.P.-4).
65% GASOLINE, 35% LIGHT PETROLEUM DISTILLATES (CURL 77).
U.S. AIR FORCE WIDE-CUT AVIATION TURBINE FUEL (DUKEK 78).
- 2.0 API GRAVITY: 44.8 TO 56.7 (DUKEK 78)
- 3.0 DENSITY (g/mL):
@ 15 °C: 0.751 TO 0.802 (DUKEK 78)
APPROXIMATELY 0.80 (NAVAL 77)
- 4.0 VISCOSITY:
- 5.0 INTERFACIAL TENSIONS:
- 6.0 POUR POINT:
- 7.0 FLASH POINT (°C): -23 TO -1 (CURL 77),
APPROXIMATELY -25 (NAVAL 77)
- 8.0 REID VAPOUR PRESSURE (kPa):
max: 14-21 (DUKEK 78)
- 9.0 DISTILLATION DATA:
- | VOLUME
PERCENT | TEMPERATURE
(°C, max) |
|-------------------|--------------------------|
| 50 | 190 |
| FBP | 270 |
- (DUKEK 78)
- 10.0 EMULSION FORMATION TENDENCY & STABILITY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:
- 13.0 HYDROCARBON GROUP ANALYSIS (VOL %, maximum):
AROMATICS 25 (DUKEK 78)
- 14.0 AQUEOUS SOLUBILITY (mg/L):
in deionized water @ 20°C: 25.14 (SMITH 81)
in seawater @ 20°C: 21.41 (SMITH 81)
- 15.0 TOXICITY:
- 16.0 SULPHUR (WT %): maximum, 0.4 (DUKEK 78)

17.0 OTHERS:

17.1 AUTO-IGNITION TEMPERATURE ($^{\circ}\text{C}$): 242(CURL 77)

17.2 FREEZING POINT ($^{\circ}\text{C}$): maximum, -58(DUKEK 78)

17.3 HEAT CONTENT (MJ/kg): minimum, 42.8(DUKEK 78)

17.4 SMOKE POINT (mm): minimum, 20(DUKEK 78)

1.0 TYPE: FUEL OIL NO.1 (JET FUEL, J.P.-5).
SPECIALLY REFINED KEROSENE (CURL 77).
A HIGH FLASH POINT KEROSENE (DUKEK 78).

2.0 API GRAVITY: 35.8 TO 47.9(DUKEK 78)

3.0 DENSITY (g/mL):
@ 15 °C: 0.788 TO 0.845(DUKEK 78)
maximum, 0.844(NAVAL 77)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/s):
@ -20 °C: maximum, 8.5(DUKEK 78)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT (°C): 35 TO 63(CURL 77),
minimum, 60(NAVAL 77)
minimum, 60(DUKEK 78)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C, max)
-----	-----
10	205
FBP	290
-----	-----
(DUKEK 78)	

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (VOL %, maximum):
AROMATICS 25(DUKEK 78)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): maximum, 0.4(DUKEK 78)

17.0 OTHERS:

17.1 AUTO-IGNITION TEMPERATURE ($^{\circ}\text{C}$): 246(CURL 77)

17.2 FREEZING POINT ($^{\circ}\text{C}$): maximum, -46(DUKEK 78)

17.3 HEAT CONTENT (KJ/kg): minimum, 42.6(DUKEK 78)

17.4 SMOKE POINT (mm): minimum, 19(DUKEK 78)

- 1.0 TYPE: FUEL OIL NO.1 (JET FUEL, J.P.-6).
A HIGHER KEROSENE CUT THAN J.P.-4 WITH FEWER IMPURITIES.
- 3.0 API GRAVITY:
- 3.0 DENSITY:
- 4.0 VISCOSITY:
- 5.0 INTERFACIAL TENSIONS:
- 6.0 POUR POINT:
- 7.0 FLASH POINT ($^{\circ}\text{C}$): 38 (CURL 77)
- 8.0 VAPOUR PRESSURE:
- 9.0 DISTILLATION DATA:
- 10.0 EMULSION FORMATION TENDENCY & STABILITY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:
- 13.0 HYDROCARBON GROUP ANALYSIS:
- 14.0 AQUEOUS SOLUBILITY:
- 15.0 TOXICITY:
- 16.0 SULPHUR:
- 17.0 OTHERS:
 - 17.1 AUTO-IGNITION TEMPERATURE ($^{\circ}\text{C}$): 224 (CURL 77)

1.0 TYPE: FUEL OIL NO.1 (JET FUEL, J.P.-7).
A HIGH FLASH POINT SPECIAL KEROSENE USED IN ADVANCED
SUPERSONIC AIRCRAFT (DUKEK 78).

3.0 API GRAVITY: 43.9 TO 50.0(DUKEK 78)

3.0 DENSITY (g/mL):
@ 15°C: 0.779 TO 0.806(DUKEK 78)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/s):
@ -20°C: maximum, 8.0(DUKEK 78)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT (°C): minimum, 60(DUKEK 78)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C, max)
10	196
FBP	288

(DUKEK 78)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (VOL %, maximum):
AROMATICS 5(DUKEK 78)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): maximum, 0.1(DUKEK 78)

17.0 OTHERS:

17.1 FREEZING POINT ($^{\circ}\text{C}$): maximum, -43(DUKEK 78)

17.2 HEAT CONTENT (KJ/kg): minimum, 43.5(DUKEK 78)

17.3 SMOKE POINT (mm): minimum, 35(DUKEK 78)

1.0 TYPE: FUEL OIL NO.1 (JET FUEL, J.P.-8).
A KEROSENE MODELLED ON JET A-1 WHICH IS USED IN NEW
MILITARY AIRCRAFT (DUKEK 78).

3.0 API GRAVITY: 36.8 TO 50.9 (DUKEK 78)

3.0 DENSITY (g/mL):
@ 15°C: 0.775 TO 0.840 (DUKEK 78)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/s):
@ -20°C: maximum, 8.0 (DUKEK 78)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT (°C): minimum, 38 (DUKEK 78)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C, max)
10	205
FBP	300

(DUKEK 78)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (VOL %, maximum):
AROMATICS 25 (DUKEK 78)

14.0 AQUEOUS SOLUBILITY (mg/L):
in deionized water @ 20°C: 2.00 (SMITH 81)
in seawater @ 20°C: 1.61 (SMITH 81)

15.0 TOXICITY:

16.0 SULPHUR (WT %): maximum, 0.4 (DUKEK 78)

17.0 OTHERS:

17.1 FREEZING POINT ($^{\circ}\text{C}$): maximum, -50(DUKEK 78)

17.2 HEAT CONTENT (KJ/kg): minimum, 42.8(DUKEK 78)

17.3 SMOKE POINT (mm): minimum, 20(DUKEK 78)

1.0 TYPE: FUEL OIL NO.1 (JET FUEL A).

ALSO KNOWN AS JET A KEROSENE OR TURBO FUEL A.

A PETROLEUM DISTILLATE BLENDED FROM KEROSENE FRACTIONS
AND USED IN CIVIL AVIATION. OPERATIONAL FUEL FOR
COMMERCIAL TURBOPROP AND TURBOJET AIRCRAFT IN U.S.
(ESSO 73)

2.0 API GRAVITY: 42.0(ESSO 73)

36.8 TO 50.9(DUKEK 78)

3.0 DENSITY (g/mL):

@ 15°C: 0.775 TO 0.840(DUKEK 78)

@ 15°C: 0.7753 TO 0.8398(ASTM D 1655)

@ 15.6°C: 0.816(ESSO 73)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/s):

@ -34.4°C: 7.9(ESSO 73)

@ -20°C: maximum, 8.0(DUKEK 78) (ASTM D 1655)

@ 0°C: 2.1(DUKEK 78)

@ 15°C: 1.6(DUKEK 78)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m):

@ 20°C: 23.3(CRC 83)

@ 40°C: 21.7(CRC 83)

@ 60°C: 20.2(CRC 83)

6.0 POUR POINT:

7.0 FLASH POINT (°C): minimum, 38(DUKEK 78) (ASTM D 1655)
46(ESSO 73)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
IBP	163(ESSO 73)
10	204, MAX(DUKEK 78) (ASTM D 1655)
	179(ESSO 73)
20	184(ESSO 73)
50	203(ESSO 73)
90	232(ESSO 73)
FBP	300, MAX(DUKEK 78) (ASTM D 1655)
	259(ESSO 73)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (VOL %):

AROMATICS	20(DUKEK 78)
	25(MAX, ASTM D 1655)
	16(ESSO 73)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): maximum, 0.3(DUKEK 78)(ASTM D 1655)
0.05(ESSO 73)

17.0 OTHERS:

17.1 FREEZING POINT ($^{\circ}\text{C}$): maximum, -40(DUKEK 78)(ASTM D 1655)
-44(ESSO 73)

17.2 HEAT CONTENT (KJ/kg): minimum, 42.8(DUKEK 78)

17.3 SMOKE POINT (mm): minimum, 20(DUKEK 78)
minimum, 18(ASTM D 1655)
23(ESSO 73)

1.0 TYPE: FUEL OIL NO.1 (JET FUEL A-1).

ALSO KNOWN AS JET A-1 KEROSENE OR TURBO FUEL A-1.

A PETROLEUM DISTILLATE BLENDED FROM KEROSENE FRACTIONS
AND USED IN CIVIL AVIATION. JET A-1 IS SIMILAR TO JET A
EXCEPT FOR A LOWER FREEZING POINT. OPERATIONAL FUEL FOR
ALL TURBOPROP AND TURBOJET AIRCRAFT REQUIRING A LOW
FREEZING POINT PRODUCT. (ESSO 73)

3.0 API GRAVITY: 44.0(ESSO 73)

3.0 DENSITY (g/mL):

@ 15.6°C: 0.806(ESSO 73)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/s):

@ -34.4°C: 7.9(ESSO 73)

@ 0°C: 1.5(DUKEK 78)

@ 15°C: 1.2(DUKEK 78)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/M):

@ 20°C: 23.3(CRC 83)

@ 40°C: 21.7(CRC 83)

@ 60°C: 20.2(CRC 83)

6.0 POUR POINT:

7.0 FLASH POINT (°C): 42(ESSO 73)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
-----	-----
IBP	163(ESSO 73)
10	179(ESSO 73)
20	184(ESSO 73)
50	203(ESSO 73)
90	232(ESSO 73)
FBP	259(ESSO 73)
-----	-----

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (VOL %):
 AROMATICS 16 (ESSO 73)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.05 (ESSO 73)

17.0 OTHERS:

 17.1 FREEZING POINT (°C): -51 (ESSO 73)

 17.2 SMOKE POINT (mm): 26 (ESSO 73)

- 1.0 TYPE: FUEL OIL NO.1 (JET FUEL B).
ALSO KNOWN AS JET B WIDE-CUT OR TURBO FUEL B.
A WIDE-BOILING-RANGE PETROLEUM DISTILLATE BLENDED FROM
GASOLINE AND KEROSENE FRACTIONS. OPERATIONAL FUEL FOR
U.S. AND NATO MILITARY AIRCRAFT AND FOR MANY COMMERCIAL
TURBOPROP AND TURBOJET AIRCRAFT. (ESSO 73)
- 3.0 API GRAVITY: 53.8(ESSO 73)
44.8 TO 56.7(DUKEK 78)
- 3.0 DENSITY (g/mL):
@ 15°C: 0.751 TO 0.802(DUKEK 78)
@ 15.6°C: 0.764(ESSO 73)
- 4.0 VISCOSITY:
- 5.0 INTERFACIAL TENSIONS:
5.1 OIL-AIR (mN/m):
@ 20°C: 21.8(CRC 83)
@ 40°C: 20.5(CRC 83)
@ 60°C: 18.4(CRC 83)
- 6.0 POUR POINT:
- 7.0 FLASH POINT:
- 8.0 VAPOUR PRESSURE:
@ 38°C: maximum, 21(DUKEK 78)
- 9.0 DISTILLATION DATA:
- | VOLUME
PERCENT | TEMPERATURE
(°C) |
|-------------------|---------------------|
| IBP | 72(ESSO 73) |
| 10 | 124(ESSO 73) |
| 20 | 135(ESSO 73) |
| 50 | 159(ESSO 73) |
| | 188, MAX(DUKEK 78) |
| 90 | 193(ESSO 73) |
| FBP | 235(ESSO 73) |
- 10.0 EMULSION FORMATION TENDENCY & STABILITY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (VOL %):

AROMATICS maximum, 20(DUKEK 78)

11(ESSO 73)

OLEFINS 1.0(ESSO 73)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): maximum, 0.3(DUKEK 78)

0.04(ESSO 73)

17.0 OTHERS:

17.1 FREEZING POINT ($^{\circ}\text{C}$): maximum, -50(DUKEK 78)

-60(ESSO 73)

17.2 HEAT CONTENT (KJ/kg): minimum, 42.8(DUKEK 78)

17.3 SMOKE POINT (mm): minimum, 20(DUKEK 78)

29.0(ESSO 73)

1.0 TYPE: FUEL OIL NO.2.

ALSO SEE DIESEL FUEL OIL AND HEATING FUEL OIL.

2.0 API GRAVITY: 30 MIN(ASTM 80)
31.6(PANCIROV 74)

3.0 DENSITY (g/mL):

		WEATHERING
TEMP		(%)
(°C)	0	

0	0.874 (EETD 84)	
	0.849 (MACKAY 82B)	
	0.865 TO 0.908 (CURL 77)	
15	0.866 (EETD 84)	
	0.855 TO 0.898 (CURL 77)	
	0.8757 (MAX, ASTM D 396)	
16.5	0.8762 (MAX, ASTM D 396)	
	0.854 TO 0.897 (CURL 77)	
20	0.840 (MACKAY 82B)	

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	7.74 (MACKAY 82B)
20	4.04 (MACKAY 82B)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING	
	(%)	
-----	0	-----
0	1.77 TO 4.00 (CURL 77)	
15	2.53 TO 6.13 (CURL 77)	
38	2.0 TO 3.6 (ASTM D 396)	
	1.53 TO 3.19 (CURL 77)	
40	1.9 TO 3.4 (ASTM D 396)	
	1.47 TO 3.01 (CURL 77)	

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	29.0 (EETD 84)
15	27.4 (EETD 84)
20	26.2 (MACKAY 82B)

5.2 OIL-SEAWATER (mN/m or dynes/cm)

TEMP (°C)	WEATHERING (%)
0	
0	16.2 (EETD 84)
15	13.6 (EETD 84)
20	25.6 (MACKAY 82B)

5.3 OIL-WATER (mN/m or dynes/cm)

TEMP (°C)	WEATHERING (%)
0	
0	15.1 (EETD 85)
15	14.7 (EETD 85)

6.0 POUR POINT (°C):

-27 (MACKAY 82B)
-6 (MAX, ASTM D 396)
-20 (FINGAS 79)
-7 (CURL 77)

7.0 FLASH POINT (°C):

104 (MACKAY 82B)
38 (MIN, ASTM D 396)
91 (C.C.) (EETD 84)
52-96 (EETD 84)
55 (FINGAS 79)
38 (CURL 77)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	VAPOUR TEMPERATURE	LIQUID TEMPERATURE
IBP	180 TO 360 (FINGAS 79)	240 (MACKAY 82B)
5		254 (MACKAY 82B)
10		260 (MACKAY 82B)
15		267 (MACKAY 82B)
20		273 (MACKAY 82B)
25		279 (MACKAY 82B)
30		286 (MACKAY 82B)
35		292 (MACKAY 82B)
90	282 TO 338 (ASTM D 396)	

10.0 EMULSION FORMATION TENDENCY & STABILITY:
FORMS NO EMULSION (MACKAY 82B)10.1 EMULSION FORMATION TENDENCY:
WEATHERING
(%)

TEMP (°C)	
0	0 (EETD 84)
15	0 (EETD 84)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
0	0 (EETD 84)
15	0 (EETD 84)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	N/A (EETD 84)
15	N/A (EETD 84)

11.0 WEATHERING:

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (%)	
	0	
0	86 (EETD 85)	
15	75 (EETD 85)	

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (%)	
	0	
0	26 (EETD 85)	
15	24 (EETD 85)	

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	61.8 (PANCIROV 74) (ASTM D-2007)
AROMATICS	38.2 (PANCIROV 74) (ASTM D-2007)
	25 (CURL 77)
POLARS	0 (PANCIROV 74)
ASPHALTENES	0 (PANCIROV 74)
	0.36 (MACKAY 82B)
PARAFFINS	30 (CURL 77)
NAPHTHENES	45 (CURL 77)

14.0 AQUEOUS SOLUBILITY (mg/L):

in freshwater @ 20°C:	3.12 (MACKAY 82B)
diesel fuel in freshwater @ 22°C:	2.8 (SUNTIO 86)
heating oil in freshwater @ 22°C:	0.3 (SUNTIO 86)
in distilled water @ 5°C:	2.7 (MAIJANEN 84)
in distilled water @ 20°C:	3.2 (MAIJANEN 84)
in distilled water:	9.3 (MURRAY 84)
in seawater @ 5°C:	2.05 (MAIJANEN 84)
in seawater @ 20°C:	2.50 (MAIJANEN 84)
in seawater:	8.7 (ANDERSON 74)

15.0 TOXICITY:

ACUTE TOXICITY OF WATER SOLUBLE FRACTION (mg/L):

SPECIES	24 hour LC50	48 hour LC50	96 hour LC50
POLYCHAETA:			
NEANTHES ARENACEODENTATA	>8.7(ROSSI 76)	3.2(ROSSI 76)	2.7(ROSSI 76)
CAPITELLA CAPITATA	>8.7(ROSSI 76)	3.5(ROSSI 76)	2.3(ROSSI 76)
NEREIS VEXILLOSA			>3.36/>8.19(RICE 79)
CRUSTACEA:			
MYSIDOPSIS ALMYRA	2.6(ANDERSON 74)	0.9(ANDERSON 74)	
PALAEONETES FUGIO	4.4(ANDERSON 74)	4.1(ANDERSON 74)	3.5(ANDERSON 74)
PENAEUS AZTECUS	5.0(ANDERSON 74)	5.0(ANDERSON 74)	4.9(ANDERSON 74)
LIGIA EXOTICA	>8.7(DILLON 78)	>8.7(DILLON 78)	>8.7(DILLON 78)
LUCIFER FAXONI	8.9(LEE 78)	4.6(LEE 78)	3.2(LEE 78)
ORCHOMENE PINGUIS			>1.74/>0.48(RICE 79)
ACANTHOMYSIS PSEUDOMACROPSIS			2.31/>0.45(RICE 79)
EUALUS SUCKLEYI			1.10/0.59(RICE 79)
CRANGON ALASKENSIS			0.36/0.43(RICE 79)
PARGURUS HIRSUTICULUS			>3.36/>8.19(RICE 79)
PARALITHODES CAMTSCHAYICA			1.02/0.81(RICE 79)
FISH:			
MENIDIA BERYLLINA	5.7(ANDERSON 74)	5.2(ANDERSON 74)	3.9(ANDERSON 74)
FUNDULUS SIMILIS	5.6(ANDERSON 74)	4.7(ANDERSON 74)	3.9(ANDERSON 74)
CYPRINODON VARIEGATUS	>6.9(ANDERSON 74)	>6.9(ANDERSON 74)	6.3(ANDERSON 74)
ONCORHYNCHUS GORBUSCHA			0.97/0.54(RICE 79)
SALVELINUS MALMA			0.15/0.72(RICE 79)
MYOXOCEPHALUS POLYACANTHOCEPHALUS			1.31/2.41(RICE 79)
PLATICHTHYS STEELATUS			>0.97/>1.72(RICE 79)
PHOLIS LAETA			>0.92/>1.72(RICE 79)
MOLLUSKS:			
COLLISELLA SCUTUM			>3.36/>8.19(RICE 79)
CILAMYS HERICUS			>3.36/>8.19(RICE 79)
KATHARINA TUNICATA			>3.36/>8.19(RICE 79)
MYTILUS EDULIS			>1.25/>4.19(RICE 79)
THAIS LIMA			>3.36/>8.19(RICE 79)
NEMERTEAN:			
PARANEMERTES PEREGRINA			>3.36/>8.19(RICE 79)
ECHINODERMS:			
LEPTASTERIAS HEXACTIS			>3.36/>8.19(RICE 79)

NOTE: FOR (RICE 79) THE FIRST NUMBER REPORTED IS TOTAL AROMATICS/THE SECOND NUMBER REPORTED IS TOTAL HYDROCARBONS MEASURED BY IR SPECTROPHOTOMETRY.

ACUTE TOXICITY OF OIL-IN-WATER DISPERSION (mg/L):			
SPECIES	24 hour LC50	48 hour LC50	96 hour LC50
CRUSTACEA:			
MYSIDOPSIS ALMYRA	1.6 (ANDERSON 74)	1.3 (ANDERSON 74)	
PALAEONETES PUGIO	3.8 (ANDERSON 74)	3.4 (ANDERSON 74)	3.0 (ANDERSON 74)
PENAEUS AZTECUS	9.4 (ANDERSON 74)	9.4 (ANDERSON 74)	9.4 (ANDERSON 74)
LIGIA EXOTICA	73.0 (DILLON 78)	73.0 (DILLON 78)	36.5 (DILLON 78)
FISH:			
MENIDIA BERYLLINA	260 (ANDERSON 74)	125 (ANDERSON 74)	
FUNDULUS SIMILIS	48 (ANDERSON 74)	36 (ANDERSON 74)	33 (ANDERSON 74)
CYPRINODON VARIEGATUS	250 (ANDERSON 74)	200 (ANDERSON 74)	93 (ANDERSON 74)

COMBUSTION PRODUCT TOXICITY: NO GREAT HAZARD (OHMTADS 81)

POTENTIAL FOR ACCUMULATION: NEGATIVE (OHMTADS 81)

GENERAL EFFECT: INHALATION: HEADACHE & STUPOR (OHMTADS 81)

16.0 SULPHUR (WT %): 0.5 (MAX, ASTM D 396)

0.32 (PANCIROV 74)

0.36 (EETD 86)

WINTER GRADE DIESEL: 0.16 (EETD 86)

17.0 OTHERS:

17.1 AUTO-IGNITION POINT ($^{\circ}\text{C}$): 257(OHMTADS 81)17.2 BOILING POINT ($^{\circ}\text{C}$): 232(OHMTADS 81)17.3 BOILING RANGE ($^{\circ}\text{C}$): 34 TO 185(CURL 77)

17.4 ODOUR THRESHOLD, MEDIUM (PPM): 0.082(OHMTADS 81)

17.5 COLOUR IN WATER: DARK BLUE PURPLE(OHMTADS 81)

17.6 NITROGEN CONTENT (WT %): 0.024(PANCIROV 74)

17.7 METALS (PPM): NICKEL: 0.5(PANCIROV 74)
VANADIUM: 1.5(PANCIROV 74)

17.8 WAX (WT %): 2.9(MACKAY 82B)

17.9 COMPOSITIONAL ANALYSIS (WT %):

SATURATES:

N-ALKANES (C_{10} TO C_{21})	8.07
ISO-ALKANES	22.3
1-RING CYCLOALKANES	17.5
2-RING CYCLOALKANES	9.4
3-RING CYCLOALKANES	4.5

AROMATICS:

BENZENES	10.3
INDANS & TETRALINS	7.3
DINAPHTHENO BENZENES	4.6
NAPHTHALENE	0.2
METHYLNAPHTHALENES	2.1
DIMETHYLNAPHTHALENES	3.2
OTHER NAPHTHALENES	0.4
ACENAPHTHENES	3.8
ACENAPHTHALENES	5.4
BENZOTHIOPHENES	0.9 (CLARK 77)

1.0 TYPE: TYPICAL HEATING FUEL OIL.

2.0 API GRAVITY: 32.1(API 81)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.8641(API 81)

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
-----	-----
IBP	116
5	171
10	194
15	207
20	216
25	226
30	233
35	243
40	251
45	258
50	267
55	273
60	280
65	287
70	297
75	306
80	317
85	327
90	339
95	356
FBP	399(API 81)

NOTE: (API 81) DATA FROM SIMULATED DISTILLATION ASTM
METHOD D 2887

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

in fresh water @ 22°C: 0.3(SUNTIO 86)
in fresh water: 55.97(MACLEAN 88)
in seawater: 50.92(MACLEAN 88)

15.0 TOXICITY:

ACUTE TOXICITY OF WATER SOLUBLE FRACTIONS TO DAPHNIA MAGNA:

48 hour EC₅₀: 1.9(MACLEAN 88)
0.01(BOBRA 88)
48 hour LC₅₀: 2.18(MACLEAN 88)
0.01(BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTIONS TO ARTEMIA SPP.:

48 hour EC₅₀: 8.35(MACLEAN 88)
0.04(BOBRA 88)
48 hour LC₅₀: 11.16(MACLEAN 88)
0.05(BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE
SPECTROSCOPY.

RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP
GC ANALYSIS.

16.0 SULPHUR (WT %): 0.19(API 81)

17.0 OTHERS:

17.1 NITROGEN (WT %): 0.014(API 81)

17.2 METALS (PPM): NICKEL: <0.1 TO 0.1(API 84)
VANADIUM: 0.1 TO 0.2(API 81)

1.0 TYPE: HIGH AROMATIC CONTENT HEATING OIL.

2.0 API GRAVITY: 33.7(API 81)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.8558(API 81)

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
IBP	138
5	181
10	199
15	210
20	219
25	227
30	235
35	245
40	253
45	261
50	269
55	275
60	282
65	288
70	297
75	305
80	316
85	325
90	336
95	352
FBP	387(API 81)

NOTE: (API 81) DATA FROM SIMULATED DISTILLATION ASTM
METHOD D 2887

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.12(API 81)

17.0 OTHERS:

17.1 NITROGEN (WT %): 0.009(API 81)

17.2 METALS (PPM): NICKEL: 0.1(API 81)
VANADIUM: 0.1 TO 0.3(API 81)

1.0 TYPE: FUEL OIL NO. 4.

IT CAN BE A HIGH-BOILING-DISTILLATE OR A LIGHT
RESIDUAL OF CRUDE OIL, OR IT CAN BE PREPARED BY
BLENDING 40% FUEL OIL NO.2 AND 60% FUEL OIL NO.6.
(CURL 77).

2.0 API GRAVITY (15/15°C): 24.9 TO 23.5(CURL 77)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
--------------	---------------------

0	0.914 TO 0.922 (CURL 77) 0.938 (MACKAY 82B)
15	0.904 TO 0.912 (CURL 77)
20	0.901 TO 0.909 (CURL 77) 0.925 (MACKAY 82B)
30	0.895 TO 0.902 (CURL 77)

NOTE: (CURL 77) DATA OBTAINED FROM A GRAPH

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
--------------	---------------------

10	47.2 (MACKAY 82B)
20	22.7 (MACKAY 82B)

4.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):
WEATHERING

TEMP ($^{\circ}\text{C}$)	0 (%)
10	40 TO 101(CURL 77)
15	33 TO 79(CURL 77)
20	27 TO 60(CURL 77)
30	18 TO 38(CURL 77)
38	5.8 TO 26.4(ASTM D 396) 2.0 TO 5.8 for No.4 Light(ASTM D 396)
40	11 TO 26(CURL 77)

NOTE: DATA OBTAINED FROM A GRAPH (CURL 77)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):
@ 20 $^{\circ}\text{C}$: 32.1(MACKAY 82B)5.2 OIL-SEAWATER (mN/m or dynes/cm):
@ 20 $^{\circ}\text{C}$: 30.23(MACKAY 82B)6.0 POUR POINT ($^{\circ}\text{C}$): -7(CURL 77)
-3(MACKAY 82B)
-6(MAX, ASTM D 396)7.0 FLASH POINT ($^{\circ}\text{C}$): 54(CURL 77)
78(MACKAY 82B)
55(MIN, ASTM D 396)
38 for No.4 Light(MIN, ASTM D 396)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA ($^{\circ}\text{C}$):

VOLUME PERCENT	LIQUID TEMPERATURE
IBP	245(MACKAY 82B)
5	257(MACKAY 82B)
10	269(MACKAY 82B)
15	281(MACKAY 82B)
20	293(MACKAY 82B)
25	305(MACKAY 82B)
30	317(MACKAY 82B)

10.0 EMULSION FORMATION TENDENCY & STABILITY:
FORMS STABLE EMULSION(MACKAY 82B)

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):
ASPHALTENES 3.2(MACKAY 82B)

14.0 AQUEOUS SOLUBILITY (mg/L):
@ 20°C: 6.46(MACKAY 82B)

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 AUTO-IGNITION TEMPERATURE (°C): 263(CURL 77)

17.2 WAX (WT %): 5.5(MACKAY 82B)

1.0 TYPE: FUEL OIL NO. 5, NAVY SPECIAL OR BUNKER B FUEL OIL.
CAN BE PREPARED BY ADDING 20 TO 25% FUEL OIL NO. 2 TO
75 TO 80% FUEL OIL NO.6 (CURL 77).
LIGHT FUEL OIL NO.5 AND HEAVY FUEL OIL NO.5 (CURL 77).

2.0 API GRAVITY: MINIMUM 11.5 (NAVAL 77)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)	
	0	
0	0.932 TO 0.957 (CURL 77)	
15	0.923 TO 0.948 (CURL 77)	
20	0.920 TO 0.945 (CURL 77)	
30	0.913 TO 0.938 (CURL 77)	

NOTE: DATA OBTAINED FROM A GRAPH (CURL 77)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	FUEL OIL No.5	
	LIGHT	HEAVY
10	200 TO 473 (CURL 77)	>473 (CURL 77)
15	152 TO 313 (CURL 77)	>313 (CURL 77)
20	123 TO 233 (CURL 77)	>233 (CURL 77)
25	100 TO 165 (CURL 77)	165 TO 327 (CURL 77)
30	74 TO 125 (CURL 77)	125 TO 200 (CURL 77)
38	26.4 TO 65 (ASTM D 396)	65 TO 194 (ASTM D 396)
40	40 TO 75 (CURL 77)	75 TO 100 (CURL 77)

NOTE: DATA OBTAINED FROM A GRAPH (CURL 77)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -9.4 (MAX, NAVAL 77)

7.0 FLASH POINT ($^{\circ}\text{C}$): >54 (CURL 77)
60 (MIN, NAVAL 77)
55 (MIN, ASTM D 396)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: AUTOMOTIVE GASOLINE. DATA FROM REFERENCE (EETD 84/85)
ARE BASED ON AUTOMOTIVE GASOLINE SAMPLE PURCHASED FROM
A SERVICE STATION IN THE SUMMER 1984.

2.0 API GRAVITY: 60 (FINGAS 79)
62.4 (15/15°C) (EETD 84)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
0	
0	0.746 (EETD 84)
5	0.7501 (MAIJANEN 84)
15	0.729 (EETD 84)
20	0.7340 (MAIJANEN 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	
0	0.75 (EETD 85)
5	0.53 (MAIJANEN 84)
15	0.62 (EETD 85)
20	0.45 (MAIJANEN 84)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (%)
0	
0	0.69 to 0.95 (CURL 77)
15	0.57 to 0.80 (CURL 77)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	20.9 (EETD 84)
15	19.8 (EETD 84)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	19.8 (EETD 84)
15	18.6 (EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	19.7 (EETD 84)
15	18.0 (EETD 84)

6.0 POUR POINT (°C): N/A (FINGAS 79)

7.0 FLASH POINT (°C): -43 (OHMTADS 81)
-43 (CURL 77)
-40 (FINGAS 79)

8.0 REID VAPOUR PRESSURE (kPa): 62 TO 103 (ASTM D 439)

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
10	50 TO 70 (ASTM D 439)
50	77 TO 121 (ASTM D 439)
90	185 TO 190 (ASTM D 439)
FBP	225 (ASTM D 439)
RESIDUE	2% MAX (ASTM D 439)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (%)
0	54 (EETD 85)
15	46 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (%)
0	38 (EETD 84)
15	38 (EETD 84)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

PARAFFINS 50 (CURL 77)
 NAPHTHENES 40 (CURL 77)
 AROMATICS 10 (CURL 77)
 may contain up to 30% Alkenes (CURL 77)

GROUP	STRAIGHT-RUN	BLENDED
SATURATES	39.61	57.65
AROMATICS	46.24	32.56
OLEFINS	14.15	7.03
DIOLEFINS		2.48
BENZENE		0.28 (WATERS 82)

14.0 AQUEOUS SOLUBILITY (mg/L):

unleaded gasoline in fresh water @ 22°C: 112 (SUNTIO 86)
 unleaded gasoline in fresh water: 306.6 (MACLEAN 88)
 leaded gasoline in fresh water @ 22°C: 240 (SUNTIO 86)
 leaded gasoline in fresh water: 169 (MACLEAN 88)
 summer gasoline in distilled water @ 22°C: 98 (MAIJANEN 84)
 regular gasoline in distilled water: 186.7 (MURRAY 84)
 unleaded gasoline in seawater: 260.9 (MACLEAN 88)
 leaded gasoline in seawater: 132.4 (MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHIA MAGNA:

 leaded gasoline, 48 hour EC50: 6.25(MACLEAN 88)
 8.88(BOBRA 88)
 unleaded gasoline, 48 hour EC50: 4.91(MACLEAN 88)
 1.79(BOBRA 88)
 leaded gasoline, 48 hour LC50: 13.5(MACLEAN 88)
 19.2(BOBRA 88)
 unleaded gasoline, 48 hour LC50: 50.3(MACLEAN 88)
 18.4(BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

 leaded gasoline, 48 hour EC50: 19.2(MACLEAN 88)
 27.8(BOBRA 88)
 unleaded gasoline, 48 hour EC50: 25.1(MACLEAN 88)
 8.6(BOBRA 88)
 leaded gasoline, 48 hour LC50: 21.3(MACLEAN 88)
 30.9(BOBRA 88)
 unleaded gasoline, 48 hour LC50: 51.4(MACLEAN 88)
 17.7(BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO LARVAL RAINBOW TROUT (unleaded gasoline):

 48 hour LC₅₀ (closed container): 6.80(LOCKHART 87)
 48 hour LC₅₀ (open container): 5.40(LOCKHART 87)

 48 hour LC₅₀, juvenile shad (freshwater): 91(TAGATZ 61)

16.0 SULPHUR (WT %): 0.07(EETD 86)

 unleaded grade: maximum, 0.10(ASTM D 439)
 conventional grade: maximum, 0.15(ASTM D 439)

17.0 OTHERS:

17.1 LEAD CONTENT (g/L):

unleaded grade: maximum, 0.013 (ASTM D 439)
conventional grade: maximum, 1.1 (ASTM D 439)

17.2 AUTO-IGNITION TEMPERATURE ($^{\circ}\text{C}$): 280 (OHMTADS 81)
257 (CURL 77)

17.3 EXPLOSION LIMITS OF VAPOUR IN AIR:

UPPER: 7.6 PERCENT (CURL 77)
LOWER: 1.4 PERCENT (CURL 77)

17.4 BOILING POINT ($^{\circ}\text{C}$): 38 (OHMTADS 81)
30 TO 200 (FINGAS 79)

17.5 ODOUR THRESHOLD (PPM):

UPPER: 0.01 (OHMTADS 81)
LOWER: 0.005 (OHMTADS 81)

17.6 COMPOSITIONAL ANALYSIS (WT %):

COMPOUND	Leaded	Unleaded	Super Unleaded
-----	-----	-----	-----
isobutane	1.561	2.241	1.180
n-hexane	11.04	11.13	12.93
unknown	ND	0.511	ND
n- & iso pentanes	8.320	8.936	6.144
2-pentane	8.942	6.149	2.461
unknown	0.199	2.657	1.677
1-pentane	2.235	2.959	1.948
2-methylpentane	6.322	5.392	4.325
3-methylpentane	3.353	2.634	1.873
unknown (MW=86)	4.030	1.912	1.488
2-ethyl-1-butene	1.149	1.813	0.997
unknown	ND	0.841	ND
methylcyclopentane	3.851	3.011	2.971
unknown (MW=100)	3.643	3.033	2.178
3-ethylpentane	2.736	1.857	1.410
isooctane	1.961	1.815	8.693
n-heptane	2.293	1.230	0.247
1-methyl-1-cyclohexane	1.022	1.368	0.199
benzene	3.879	3.238	4.352
unknown	0.355	0.367	ND
unknown (MW=114)	1.916	1.616	3.800
unknown (MW=114)	1.380	1.048	5.830
unknown	ND	ND	1.466
1,2-dimethylcyclohexane	0.643	0.550	0.203
2,4-dimethylheptane	1.801	1.300	0.631
unknown (MW=124)	0.466	0.511	0.426
-----	-----	-----	-----

17.6 COMPOSITIONAL ANALYSIS (continued):

COMPOUND	Leaded	Unleaded	Super Unleaded
-----	-----	-----	-----
toluene & 1,2-dichloroethane	4.457	4.792	5.966
4-methyloctane	0.766	0.669	0.516
4-n-propylheptane	0.536	0.451	0.543
n-nonane	0.796	0.663	0.402
ethylbenzene	1.239	1.357	1.450
p & m xylenes			
& 1,2-dibromomethane			
& phenylenediamine	3.985	4.751	5.166
3,4-dimethylheptane	0.114	0.104	0.038
o-xylene	1.571	1.856	2.244
2,6-dimethyloctane	0.266	0.266	0.015
n-propylbenzene	0.347	0.475	0.783
methyl ethyltoluene	1.723	2.251	3.033
cumene	1.118	1.354	1.897
1,2,4-trimethylbenzene			
& o-ethyltoluene	1.939	2.365	3.019
vinyl-2-ethyl hexyl ether	0.155	0.141	0.042
m-styrene & n-butylbenzene	1.403	1.736	1.586
dimethyl ethylbenzene	0.430	0.534	0.461
diethylbenzene	1.448	1.741	1.200
1,2,4,5-tetramethylbenzene	ND	ND	0.133
n-dodecane	0.574	0.757	0.216
1,1-dimethyl ethylbenzene	1.000	1.323	0.924
ethyl styrene	0.589	0.824	0.441
2,6-dimethyl styrene	0.971	1.369	0.822
unknown	0.596	0.964	0.451
dimethyl isopropylbenzene	0.356	0.520	0.327
2,6-dimethylundecane	0.185	0.229	0.520

(BRUELL 85)

1.0 TYPE: GAS TURBINE FUEL OIL.

GRADE 0-GT: NAPHTHAS AND OTHERS LOW FLASH DISTILLATES.

GRADE 1-GT: LIGHT DISTILLATES INCLUDING SOME GAS OIL FRACTIONS.

GRADE 2-GT: HEAVIER DISTILLATES THAN GRADE 1-GT. SIMILAR TO NO.2 FUEL OIL.

GRADE 3-GT: RESIDUAL FUEL THAT MEETS LOW ASH REQUIREMENTS.

GRADE 4-GT: SIMILAR TO GRADE 3-GT BUT WITH NO ASH RESTRICTIONS. (ASTM D 2880)

2.0 API GRAVITY:

grade 1-GT: maximum, 34.8 (ASTM D 2880)

grade 2-GT: maximum, 29.9 (ASTM D 2880)

3.0 DENSITY (g/mL):

@ 15°C: grade 1-GT: minimum, 0.850 (ASTM D 2880)

grade 2-GT: minimum, 0.876 (ASTM D 2880)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/s):

TEMP (°C)	0-GT	1-GT	2-GT	GRADE 3-GT	4-GT
0	0.8 (DUKEK 78)	3.9 (DUKEK 78)	8.0 (DUKEK 78)	150 (DUKEK 78)	150 (DUKEK 78)
40	1.3-2.4 (ASTM D2880)		1.9-4.1 (ASTM D2880)	5.5min (ASTM D2880)	5.5min (ASTM D2880)
50				638max (ASTM D2880)	638max (ASTM D2880)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C):

grade 1-GT: maximum, 38 (ASTM D 2880)

grade 2-GT: maximum, 38 (ASTM D 2880)

grade 3-GT: maximum, 54 (ASTM D 2880)

grade 4-GT: maximum, 66 (ASTM D 2880)

7.0 FLASH POINT (°C):

grade 1-GT: maximum, -18 (ASTM D 2880)

grade 2-GT: maximum, -7 (ASTM D 2880)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME
PERCENTTEMPERATURE
(°C)-----
90-----
grade 1-GT: 288, max(ASTM D 2880)
grade 2-GT: 282 TO 338 (ASTM D 2880)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: GRANITE POINT CRUDE OIL, OFFSHORE COOK INLET, ALASKA.

2.0 API GRAVITY: 42.8(COLEMAN 78)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.812(COLEMAN 78)

4.0 VISCOSITY (Saybolt Universal seconds):
@ 37.8 °C: 34(COLEMAN 78)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): <-15(COLEMAN 78)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

CUT TEMPERATURE (°C)	VOLUME PERCENT
27	IBP
50	6.0
75	9.1
100	17.7
125	27.1
150	33.5
175	40.0
200	45.1
225	50.6
250	56.1
275	63.3

(COLEMAN 78)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.02(COLEMAN 78)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 1.1(COLEMAN 78)

17.2 NITROGEN (WT %): 0.039(COLEMAN 78)

17.3 COLOUR: BROWNISH GREEN(COLEMAN 78)

- 1.0 TYPE: GULF ALBERTA L & M CRUDE OIL.
- 2.0 API GRAVITY: 35.1(AALUND 83A)
- 3.0 DENSITY (g/mL):
 - @ 21 °C: 0.8486(AALUND 83A)
- 4.0 VISCOSITY:
 - 4.1 DYNAMIC VISCOSITY:
 - 4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
 - @ 40 °C: 4.86 (AALUND 83A)
- 5.0 INTERFACIAL TENSIONS:
- 6.0 POUR POINT (°C): -27.5(AALUND 83A)
- 7.0 FLASH POINT:
- 8.0 REID VAPOUR PRESSURE (kPa): 36.4(AALUND 83A)
- 9.0 DISTILLATION DATA:
- 10.0 EMULSION FORMATION TENDENCY & STABILITY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:
- 13.0 HYDROCARBON GROUP ANALYSIS:
- 14.0 AQUEOUS SOLUBLITY:
- 15.0 TOXICITY:
- 16.0 SULPHUR (PPM): 9,800(AALUND 83A)

17.0 OTHERS:

17.1 H₂S (PPM): 58.1(AALUND 83A)17.2 METALS (PPM): NICKEL: 10.10(AALUND 83)
VANADIUM: 9.00(AALUND 83)

17.3 YIELD ON CRUDE:

	----- RANGE, °C -----	----- VOL % -----
NAPHTHA	C ₅ - 190	30.60
KEROSINE	190 - 277	14.20
DISTILLATE	277 - 343	8.53
GAS OIL	343 - 565	31.43
RESIDUE	565 +	15.2

(AALUND 83A)

1.0 TYPE: GULLFAKS CRUDE OIL. NORWAY, NORTH SEA.

2.0 API GRAVITY: 28.6(AALUND 83B)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (VOL %)			
	0	8.4	18.0	27.7
15.5	0.882 (DALING 87)	0.893 (DALING 87)	0.905 (DALING 87)	0.914 (DALING 87)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)			
	0	8.4	18.0	27.7
6	28 (DALING 87)	47 (DALING 87)	120 (DALING 87)	444 (DALING 87)
13	20 (DALING 87)	33 (DALING 87)	72 (DALING 87)	241 (DALING 87)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 37.8°C: 10.14(AALUND 83B)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL:

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)			
	0	8.4	18.0	27.7
13	13 (DALING 87)	13 (DALING 87)	15 (DALING 87)	17 (DALING 87)

5.3 OIL-WATER:

6.0 POUR POINT (°C):

WEATHERING
(VOL %)POUR POINT
(°C)

0	<-34 (DALING 87) -45 (AALUND 83B)
8.4	-26 (DALING 87)
18.0	-15 (DALING 87)
27.7	-9 (DALING 87)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

For oil weathered 27.7 % by volume:

SATURATES	52.1
AROMATICS	40.0
POLARS	6.8
ASPHALTENES	1.0 (DALING 87)

WEATHERING
(VOL %)

ASPHALTENES

"hard"

"soft"

0	0.02 (DALING 87)	0.49 (DALING 87)
8.4	0.02 (DALING 87)	0.52 (DALING 87)
18.0	0.03 (DALING 87)	0.58 (DALING 87)
27.7	0.03 (DALING 87)	0.65 (DALING 87)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.44 (AALUND 83B)

17.0 OTHERS:

17.1 WAX (WT %):

WEATHERING
(VOL %)WAX CONTENT
(^{WT} %)

0	1.60 (DALING 87)
8.4	1.72 (DALING 87)
18.0	1.90 (DALING 87)
27.7	2.14 (DALING 87)

17.2 YIELD ON CRUDE:

	RANGE, °C	WT %
GASOLINE	20 - 70	0.8
GASOLINE	70 - 100	2.6
GASOLINE	100 - 150	7.0
GASOLINE	150 - 190	6.6
KEROSINE	150 - 205	9.2
GAS OIL	205 - 343	28.4
RESIDUE	343 +	51.8

(AALUND 83B)

1.0 TYPE: HIBERNIA CRUDE OIL.

OIL SAMPLE RECEIVED FROM EPA OHMSETT, 1986.

2.0 API GRAVITY (15/15°C): 28.3(EETD 86)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.8	17.7
0	0.8970(EETD 86)	0.9131(EETD 86)	0.9246(EETD 86)
15	0.8849(EETD 86)	0.9011(EETD 86)	0.9138(EETD 86)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.8	17.7
0	10,185(EETD 86)	110,500(EETD 86)	N/M(EETD 86)
15	44.2(EETD 86)	207(EETD 86)	1,471(EETD 86)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.8	17.7
0	11,354(EETD 86)	N/M(EETD 86)	N/M(EETD 86)
15	91.6(EETD 86)	229.7(EETD 86)	1,610(EETD 86)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.8	17.7
0	N/M(EETD 86)	N/M(EETD 86)	N/M(EETD 86)
15	26.2(EETD 86)	26.5(EETD 86)	27.0(EETD 86)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.8	17.7
0	N/M(EETD 86)	N/M(EETD 86)	N/M(EETD 86)
15	13.5(EETD 86)	16.7(EETD 86)	19.1(EETD 86)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.8	17.7
0	N/M(EETD 86)	N/M(EETD 86)	N/M(EETD 86)
15	16.2(EETD 86)	16.8(EETD 86)	20.9(EETD 86)

6.0 POUR POINT (°C):

WEATHERING (VOL %)	POUR POINT (°C)
0	15(EETD 86)
8.8	18(EETD 86)
17.7	21(EETD 86)

7.0 FLASH POINT (°C): -14(C.C) (EETD 86)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	137	34.5
5	217	85
10	252	115
15	282	139
20	311	160
25	336	185
30	359	210
35	382	234
40	400	253
45	417	267
50	428	284
55	440	325
	(EETD 86)	(EETD 86)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (VOL %)		
	0	8.8	17.7
0	1.0(EETD 86)	1.0(EETD 86)	1.0(EETD 86)
15	1.0(EETD 86)	1.0(EETD 86)	1.0(EETD 86)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (VOL %)		
	0	8.8	17.7
0	1.0(EETD 86)	1.0(EETD 86)	1.0(EETD 86)
15	1.0(EETD 86)	0(EETD 86)	1.0(EETD 86)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.8	17.7
0	71.8(EETD 86)	47.1(EETD 86)	23.3(EETD 86)
15	88.5(EETD 86)	N/A(EETD 86)	65.0(EETD 86)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 8101 \theta \exp(6.3 - 4522.5/TK)/TK)}{(8101/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (EETD 86)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
 OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	8.8	17.7
0	13.9 (EETD 86)	2.6 (EETD 86)	2.3 (EETD 86)
15	33.4 (EETD 86)	16.8 (EETD 86)	9.6 (EETD 86)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.8	17.7
0	0 (EETD 86)	0 (EETD 86)	0 (EETD 86)
15	1.1 (EETD 86)	0 (EETD 86)	0 (EETD 86)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	82.1	
AROMATICS	13.5	
POLARS	2.0	
ASPHALTENES	2.4	(EETD 86)

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22°C:	23.3 (SUNTIO 86)
in salt water @ 22°C:	18.7 (SUNTIO 86)

15.0 TOXICITY:

16.0 SULPHUR:

WEATHERING (VOL %)	SULPHUR CONTENT (WT %)
0	0.65 (EETD 86)
8.8	0.64 (EETD 86)

17.0 OTHERS:

1.0 TYPE: HIBERNIA CRUDE OIL.

2.0 API GRAVITY:

3.0 DENSITY (g/mL):

For $F_v < 23.0\%$ & T between 0 and 15 °C:

$$\text{DEN} = 0.877086 + 0.001632 F_v - 0.000791 T$$

where: DEN is density of oil at T and F_v (g/mL)

F_v is volume percent of oil weathered

T is oil temperature (°C)

TEMP (°C)	WEATHERING (VOL %)		
	0	18.2	23.0
0	0.8773 (EETD 85) 0.843 (MACKAY 82A)	0.9070 (EETD 85)	0.9142 (EETD 85)
5	0.841 (MACKAY 82A)		
10	0.840 (MACKAY 82A)		
15	0.8648 (EETD 85) 0.839 (MACKAY 82A)	0.8957 (EETD 85)	0.9024 (EETD 85)
20	0.827 (MACKAY 82A)		
25	0.836 (MACKAY 82A)		

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.2	23.0
0		94,000 (EETD 86)	294,000 (EETD 86)
5	148 (MACKAY 82A)		
10	72.4 (MACKAY 82A)		
15	49.0 (MACKAY 82A)	270.5 (EETD 86)	5,100 (EETD 86)
20	33.2 (MACKAY 82A)		
25	25.6 (MACKAY 82A)		

4.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.2	23.0
0		N/M(EETD 86)	N/M(EETD 86)
15		302(EETD 86)	5,652(EETD 86)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.2	23.0
0	29.0(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	27.2(EETD 85)	28.8(EETD 85)	30.6(EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.2	23.0
0	24.2(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	21.0(EETD 85)	19.5(EETD 85)	32.7(EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.2	23.0
0	26.4(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	23.4(EETD 85)	22.0(EETD 85)	38.7(EETD 85)

6.0 POUR POINT ($^{\circ}\text{C}$):

WEATHERING (WT %)	POUR POINT ($^{\circ}\text{C}$)
0	12 (EETD 85) 6 (MACKAY 82A)
18.2	15 (EETD 85)
23.0	18 (EETD 85)

7.0 FLASH POINT ($^{\circ}\text{C}$): -10 (C.C) (EETD 85)

8.0 VAPOUR PRESSURE (kPa):

9.0 DISTILLATION DATA:

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	147	43
5	175	99
10	206	120
15	238	138
20	270	171
25	297	199
	(EETD 85)	(EETD 85)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	18.2	23.0
0	1.0 (EETD 86)	1.0 (EETD 86)	0 (EETD 86)
15	1.0 (EETD 85)	1.0 (EETD 86)	1.0 (EETD 86)

10.2 EMULSION STABILITY:

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	18.2	23.0
0	1.0 (EETD 86)	1.0 (EETD 86)	0 (EETD 86)
15	1.0 (EETD 85)	1.0 (EETD 86)	1.0 (EETD 86)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.2	23.0
0	75.0(EETD 86)	52.6(EETD 86)	N/A(EETD 86)
15	88.7(EETD 85)	75.3(EETD 86)	67.7(EETD 86)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 6143 \theta \exp(6.3 - 4326/TK)/TK)}{(6143/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (EETD 85)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	18.2	23.0
0	10(EETD 85)	4(EETD 85)	0(EETD 85)
15	48(EETD 85)	46(EETD 85)	19(EETD 85)

12.2 NATURAL DISPERSIBILITY:

TEMP (°C)	WEATHERING (VOL %)		
	0	18.2	23.0
0	0(EETD 85)	0(EETD 85)	0(EETD 85)
15	0(EETD 85)	0(EETD 85)	0(EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	79.3 (MACKAY 82A)
AROMATICS	14.5 (MACKAY 82A)
POLARS	3.52 (MACKAY 82A)
ASPHALTENES	2.68 (MACKAY 82A)

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22°C:	23.3 (SUNTIO 86)
in fresh water:	8.3 (MACLEAN 88)
in salt water @ 22°C:	18.7 (SUNTIO 86)
in seawater:	10.6 (MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

48 hour EC50:	1.08 (MACLEAN 88)
	3.0 (BOBRA 88)
48 hour LC50:	5.49 (MACLEAN 88)
	15.4 (BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

48 hour EC50:	6.34 (MACLEAN 88)
	11.1 (BOBRA 88)
48 hour LC50:	7.73 (MACLEAN 88)
	13.5 (BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE SPECTROSCOPY.

RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP GC ANALYSIS.

16.0 SULPHUR:

17.0 OTHERS:

17.1 WAX (WT %): 8.47 (MACKAY 82A)

1.0 TYPE: ISSUNGNAC CRUDE OIL.

2.0 API GRAVITY (15/15°C): 35.0(EETD 86)

3.0 DENSITY (g/mL):

For Fv < 25.0 % & T between 0 and 15 °C:

DEN = 0.861749 + 0.001289 Fv - 0.001213 T

where: DEN is density of oil at T and Fv (g/mL)

Fv is volume percent of oil weathered

T is oil temperature (°C)

TEMP (°C)	WEATHERING			
	0	4(%)	12(%)	15.1(vol%) 25.0(vol%)
0	0.8636 (EETD 85)			0.8806 (EETD 85) 0.8897 (EETD 85)
15	0.849 (EETD 84)			0.8682 (EETD 85) 0.8773 (EETD 85)
20	0.8284 (ESSO 83)	0.8459 (ESSO 83)	0.8469 (ESSO 83)	

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING		
	0	(%) 4	12
-10	DNF(ESSO 83)	DNF(ESSO 83)	DNF(ESSO 83)
0	199.4(ESSO 83)	DNF(ESSO 83)	DNF(ESSO 83)
15	3.652(ESSO 83)	6.008(ESSO 83)	6.248(ESSO 83)
25	3.005(ESSO 83)	4.564(ESSO 83)	4.566(ESSO 83)

NOTE: DNF = DID NOT FLOW

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	15.1	25.0
0	31.3 (EETD 85)	N/M (EETD 85)	N/M (EETD 85)
15	26.2 (EETD 85)	27.7 (EETD 85)	28.5 (EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	15.1	25.0
0	28.2 (EETD 85)	N/M (EETD 85)	N/M (EETD 85)
15	16.8 (EETD 85)	17.0 (EETD 85)	12.5 (EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	15.1	25.0
0	30.7 (EETD 85)	N/M (EETD 85)	N/M (EETD 85)
15	16.7 (EETD 85)	23.4 (EETD 85)	21.5 (EETD 85)

6.0 POUR POINT (°C):

WEATHERING (%)	POUR POINT (°C)
0	5 (ESSO 83)
4	6 (ESSO 83)
12	7 (ESSO 83)
15.1	11 (EETD 85)
25.0	13 (EETD 85)

7.0 FLASH POINT (°C):

WEATHERING (%)	FLASH POINT (°C)
0	-10 (ESSO 83)
4	-16 (ESSO 83)
12	48 (ESSO 83)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	WEATHERING (%)		
	0	4	12
INITIAL	-5 (ESSO 83)	38 (ESSO 83)	83 (ESSO 83)
50	254 (ESSO 83)	276 (ESSO 83)	283 (ESSO 83)
FINAL	448 (ESSO 83)	544 (ESSO 83)	538 (ESSO 83)
FINAL VOL CONT'D	100 % (ESSO 83)	96 % (ESSO 83)	98 % (ESSO 83)

WEATHERING (VOL %)				
	0		15.1	
VOLUME PERCENT	LIQUID TEMP	VAPOUR TEMP	LIQUID TEMP	VAPOUR TEMP
IBP	175	59	230	129
5	189	112	244	152
10	212	126	259	164
15	237	145	274	174
20	256	164	285	224
25	270	207	296	232
30	283	229	309	233
35	295	237	(EETD 85)	(EETD 85)
40	305	255		
	(EETD 85)	(EETD 85)		

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (VOL %)		
	0	15.1	25.0
0	1.0(EETD 86)	1.0(EETD 86)	1.0(EETD 86)
15	0(EETD 85)	0.30(EETD 86)	1.0(EETD 86)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (VOL %)		
	0	15.1	25.0
0	1.0(EETD 86)	1.0(EETD 86)	1.0(EETD 86)
15	0(EETD 85)	0.25(EETD 86)	0.40(EETD 86)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	15.1	25.0
0	90.0(EETD 86)	63.6(EETD 86)	86.7(EETD 86)
15	N/A(EETD 85)	66.7(EETD 86)	50.0(EETD 86)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 2736 \theta \exp(6.3 - 5181/TK)/TK)}{(2736/TK)}$$

where: Fv is fraction of oil weathered by volume
 ln is natural log
 θ is evaporation exposure
 exp is exponential base e
 TK is environmental temperature
 (Kelvin, K = °C + 273)

(EETD 85)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	15.1	25.0
0	16 (EETD 85)	0 (EETD 85)	0 (EETD 85)
15	91 (EETD 85)	99 (EETD 85)	85 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	15.1	25.0
0	0 (EETD 85)	0 (EETD 85)	0 (EETD 85)
15	34 (EETD 85)	0 (EETD 85)	0 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	91.5	
AROMATICS	2.7	
POLARS	0.3	
ASPALTENES	0.4	(EETD 86)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

WEATHERING (VOL %)	SULPHUR CONTENT (WT %)
0	0.08 (EETD 86)
15.1	0.07 (EETD 86)
25.0	0.10 (EETD 86)

17.0 OTHERS:

17.1 FIRE POINT ($^{\circ}\text{C}$):WEATHERING
(%)FIRE POINT
($^{\circ}\text{C}$)

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0	-10 (ENGELHARDT 84)
4	-16 (ENGELHARDT 84)
12	57 (ENGELHARDT 84)
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1.0 TYPE: ISTHMUS/REFORMA/CACTUS REFORMA BLEND CRUDE OIL,
MEXICO.

2.0 API GRAVITY: 33.0(McCASLIN 79)
32.7(PETRO-CAN 80)

3.0 DENSITY (g/mL):
@ 15 °C: 0.861(PETRO-CAN 80)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
WEATHERING

TEMP (°C)	0	(%)
10	16.05(PETRO-CAN 80)	
15.9	22.9(McCASLIN 79)	
20	10.65(PETRO-CAN 80)	
37.8	7.1(PEREZ 79)	
39	6.81(McCASLIN 79)	

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -16(PEREZ 79)
-27(PETRO-CAN 80)

7.0 FLASH POINT:

8.0 REID VAPOUR PRESSURE (kPa): 22.8(McCASLIN 79)
38.6(PEREZ 79)

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (VOLUME %):

PARAFFINS	12(McCASLIN 79)
AROMATICS	1.4(McCASLIN 79)
NAPHTHENES	3.6(McCASLIN 79)
ASPHALTENES	0.9(WT %) (PETRO-CAN 80)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 1.56(McCASLIN 79)
1.7(PEREZ 79)
1.61(PETRO-CAN 80)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 3.5(RAMSBOTTOM) (PEREZ 79)
4.2(PETRO-CAN 80)

17.2 METALS (PPM): VANADIUM: 21.1(PEREZ 79),
30.0(PETRO-CAN 80)
NICKEL: 3.0(PEREZ 79)
5.0(PETRO-CAN 80)

17.3 YIELD ON CRUDE:

		WT %	VOL %
GAS TO C ₄		0.7	0.85
LT.DISTILLATE TO 149 °C		14.55	17.5
KEROSINE	149-232 °C	16.5	17.95
GAS OIL	232-342 °C	19.5	19.8
RESIDUE	above 342 °C	48.75	43.9
(PETRO-CAN 80)			

1.0 TYPE: KOAKOAK 0-22 CRUDE OIL, BEAUFORT SEA.

2.0 API GRAVITY: 28.1(DOME 84)

3.0 DENSITY (g/mL):

@ 15.6 °C: 0.8887(DOME 84)

@ 21 °C: 0.8858(DOME 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

WEATHERING

(%)

TEMP
(°C)

0

20 19.98(DOME 84)

30 12.91(DOME 84)

40 8.890(DOME 84)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -48(DOME 84)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY &STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: KOAKOAK 0-22A CRUDE OIL, BEAUFORT SEA.

2.0 API GRAVITY: 29.5(DOME 84)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.8785(DOME 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):
WEATHERING

TEMP (°C)	0	(%)
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20	10.323(DOME 84)	
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30	6.836(DOME 84)	
----	----------------	--

40	5.022(DOME 84)	
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5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): <60(DOME 84)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: KOPANOAR CRUDE OIL, BEAUFORT SEA.

2.0 API GRAVITY: 25.7 (ENGLEHART 84)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (WT %)		
	0	3.7	11.6
16	0.8992 (ENGELHARDT 84)	0.9002 (ENGELHARDT 84)	0.9012 (ENGELHARDT 84)
20	0.900 (MACKAY 80A)	0.901 (MACKAY 80A)	0.902 (MACKAY 80A)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (WT %)		
	0	3.7	11.6
0	57 (ENGELHARDT 84)	75 (ENGELHARDT 84)	104 (ENGELHARDT 84)
15	33 (ENGELHARDT 84)	41 (ENGELHARDT 84)	54 (ENGELHARDT 84)
25	17.5 (ENGELHARDT 84)	24 (ENGELHARDT 84)	30 (ENGELHARDT 84)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C):

WEATHERING (WT %)	POUR POINT (°C)
0	-37 (ENGELHARDT 84)
3.7	-28 (ENGELHARDT 84)
11.6	-19 (ENGELHARDT 84)

7.0 FLASH POINT ($^{\circ}\text{C}$):WEATHERING
(WT %)FLASH POINT
($^{\circ}\text{C}$)

0	75 (ENGELHARDT 84)
3.7	86 (ENGELHARDT 84)
11.6	118 (ENGELHARDT 84)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA ($^{\circ}\text{C}$):

INITIAL BOILING POINT: 84 (MACKAY 80A)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

WEATHERING
(WT %)AQUEOUS SOLUBILITY
(mg/L)

0	10.4 (MACKAY 80A)
3.7	8.9 (MACKAY 80A)
11.6	3.0 (MACKAY 80A)

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 FIRE POINT ($^{\circ}\text{C}$):WEATHERING
(WT %)FIRE POINT
($^{\circ}\text{C}$)

0	85 (MACKAY 80A)
3.7	98 (MACKAY 80A)
11.6	125 (MACKAY 80A)

1.0 TYPE: KOPANOAR 2I-44 CRUDE OIL, BEAUFORT SEA.

2.0 API GRAVITY: 29.3(DOME 84)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.8685(DOME 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	

20 12.60(DOME 84)

30 8.87(DOME 84)

40 6.774(DOME 84)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -21.6(DOME 84)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: KOPANOAR M-13 CRUDE OIL, BEAUFORT SEA.

2.0 API GRAVITY: 30.9(DOME 84)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.8939(DOME 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):
WEATHERING
(%)

TEMP (°C)	0
10	61.4(DOME 84)
20	33.97(DOME 84)
30	21.67(DOME 84)
40	14.38(DOME 84)

4.2 KINEMATIC VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): 2.7(DOME 84)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: KOPANOAR M-13A CRUDE OIL, BEAUFORT SEA.

2.0 API GRAVITY: 26.7(DOME 84)

3.0 DENSITY (g/mL): @ 21 °C: 0.8938(DOME 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):
WEATHERING
(%)

TEMP (°C)	0
0	219.8(DOME 84)
4.4	128.0(DOME 84)
10	74.85(DOME 84)
15.4	43.21(DOME 84)
20	40.12(DOME 84)
30	28.46(DOME 84)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -17.5(DOME 84)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 WAX (WT %): 0.22(DOME 84)

1.0 TYPE: KUPARUK CRUDE OIL, NORTH SLOPE, ALASKA.

2.0 API GRAVITY: 23.0(AALUND 83)
28.2(COLEMAN 78)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.886(COLEMAN 78)
@ 21 °C: 0.9150(AALUND 83)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 15.6 °C: 79.98(AALUND 83)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -48.3(AALUND 83)
1.7(COLEMAN 78)

7.0 FLASH POINT:

8.0 REID VAPOUR PRESSURE (kPa): 17.94(AALUND 83)

9.0 DISTILLATION DATA (°C):

CUT TEMPERATURE (°C)	VOLUME PERCENT
69	IBP
100	3.3
125	9.2
150	12.4
175	17.1
200	21.8
225	26.2
250	31.6
275	38.0

(COLEMAN 78)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.65(COLEMAN 78)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 7.37(AALUND 83)
5.5(COLEMAN 78)

17.2 METALS (PPM): NICKEL: 19(AALUND 83)
VANADIUM: 57(AALUND 83)

17.3 NITROGEN: 1,980 PPM(AALUND 83)
0.160 %(COLEMAN 78)

17.4 H₂S (mg/m³): <361(AALUND 83)

17.5 COLOUR: BROWNISH BLACK(COLEMAN 78)

1.0 TYPE: KUWAIT CRUDE OIL.

2.0 API GRAVITY: 31.1 (LYNCH 81)
 31.1 (HMSO 76)
 31.4 (PANCIROV 74)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)		
	0	9	38.1
15	0.870 (HMSO 76)		
16	0.8692 (LYNCH 81)	0.895 (CURL 77)	0.955 (CURL 77)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (WT %)				
	0	15.1	19.5	26.7	33.0
10 (LYNCH 81)	19	97	163	865	2279

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
 @ 50 °C, 7.6 (HMSO 76), (LYNCH 81)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -20 (LYNCH 81), (HMSO 76)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

WEIGHT PERCENT	TEMP (°C)
8.3	5 TO 100 (LYNCH 81), (HMSO 76)
9.1	100 TO 160 (LYNCH 81), (HMSO 76)
12.4	160 TO 250 (LYNCH 81), (HMSO 76)
16.0	250 TO 350 (LYNCH 81), (HMSO 76)
54.2	>350 (LYNCH 81), (HMSO 76)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

HYDROCARBON GROUP	WT %
-----	-----
NAPHTHA (up to 204 °C)	22.7 (PANCIROV 74)
SATURATES	34.0 (PANCIROV 74) 54.3 (WATERS 82) 54.58 (WATERS 82) 42.4 (WATERS 82) 56.7 (WATERS 82) 43.5 (WATERS 82) 50.2 (CLARK 77)
AROMATICS	34.2 (PANCIROV 74) 25.7 (WATERS 82) 30.06 (WATERS 82) 40.4 (WATER 82) 24.3 (WATER 82) 41.6 (WATERS 82) 28.4 (CLARK 77)
POLARS	17.9 (PANCIROV 74) 17.9 (WATERS 82) 11.57 (WATERS 82) 14.8 (WATER 82) 17.9 (WATER 82) 13.8 (WATER 82) 17.0 (CLARK 77)
ASPHALTENES	3.5 (PANCIROV 74) 2.6 (WATERS 82) 3.5 (WATERS 82) 1.1 (WATERS 82) 3.5 (CLARK 77) 1.45 (LYNCH 81)
-----	-----

14.0 AQUEOUS SOLUBILITY (mg/L):

in distilled water: 35.3 (MURRAY 84)
in seawater: 21.72 (ANDERSON 74)

15.0 TOXICITY:

16.0 SULPHUR (WT %): 2.44 (PANCIROV 74)
2.53 (HMSO 76)

17.0 OTHERS:

17.1 NITROGEN (WT %): 0.14(PANCIROV 74)

17.2 METALS (PPM): NICKEL: 7.7(PANCIROV 74)
VANADIUM: 28(PANCIROV 74)

17.3 WAX (WT %): 5.5(LYNCH 81)

1.0 TYPE: KUWAIT CRUDE OIL.

2.0 API GRAVITY (15/15°C): 30.6(EETD 86)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.6	20.9
0	0.8833(EETD 86)	0.9064(EETD 86)	0.9279(EETD 86)
15	0.8722(EETD 86)	0.8977(EETD 86)	0.9165(EETD 86)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.6	20.9
0	89.5(EETD 86)	1,250(EETD 86)	29,000(EETD 86)
15	22.2(EETD 86)	55.5(EETD 86)	182(EETD 86)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.6	20.9
0	72.0(EETD 86)	1,379(EETD 86)	31,254(EETD 86)
15	28.2(EETD 86)	61.8(EETD 86)	199(EETD 86)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.6	20.9
0	28.0 (EETD 86)	29.6 (EETD 86)	31.4 (EETD 86)
15	27.8 (EETD 86)	27.9 (EETD 86)	30.5 (EETD 86)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.6	20.9
0	13.4 (EETD 86)	21.1 (EETD 86)	24.5 (EETD 86)
15	22.9 (EETD 86)	18.2 (EETD 86)	18.5 (EETD 86)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.6	20.9
0	29.1 (EETD 86)	24.8 (EETD 86)	27.3 (EETD 86)
15	28.6 (EETD 86)	21.1 (EETD 86)	27.0 (EETD 86)

6.0 POUR POINT (°C):

WEATHERING (VOL %)	POUR POINT (°C)
0	-18 (EETD 86)
9.6	- 9 (EETD 86)
20.9	3 (EETD 86)

7.0 FLASH POINT (°C): <-25 (C.C) (EETD 86)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA ($^{\circ}\text{C}$):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	119	39
5	172	97
10	205	130
15	236	153
20	267	181
25	301	208
30	333	239
35	366	264
40	392	296
45	412	312
50	424	325
55	434	335
60	441	341
65	446	342
70	451	(EETD 86)
75	458	
	(EETD 86)	

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	9.6	20.9
0	1.0 (EETD 86)	1.0 (EETD 86)	0 (EETD 86)
15	1.0 (EETD 86)	1.0 (EETD 86)	1.0 (EETD 86)

10.2 EMULSION STABILITY:

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	9.6	20.9
0	1.0 (EETD 86)	1.0 (EETD 86)	0 (EETD 86)
15	1.0 (EETD 86)	1.0 (EETD 86)	1.0 (EETD 86)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.6	20.9
0	90.0(EETD 86)	90.0(EETD 86)	N/A(EETD 86)
15	90.0(EETD 86)	90.0(EETD 86)	90.0(EETD 86)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 6870.5 \cdot \theta \cdot \exp(6.3 - 1397/TK)/TK)}{(6870.5/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (EETD 86)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	9.6	20.9
0	35.5(EETD 86)		
15	14.6(EETD 86)		

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.6	20.9
0	0(EETD 86)		
15	0.8(EETD 86)	0(EETD 86)	0(EETD 86)

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

WEATHERING
(VOL %)

SULPHUR CONTENT
(WT %)

9.6

2.69 (EETD 86)

20.9

3.18 (EETD 86)

17.0 OTHERS:

1.0 TYPE: LAGO MEDIO CRUDE OIL, VENEZUELA.

2.0 API GRAVITY: 32.6(MCCASLIN 79)

3.0 DENSITY (g/mL):

DEN = $0.880 + 0.00167 F_v - 0.00056 T$
 Where: DEN is density at F_v & T (g/mL)
 F_v is volume fraction weathered
 T is oil temperature ($^{\circ}\text{C}$)

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	8.9	14.8
0	0.880 (EETD 84)	0.898 (EETD 84)	0.906 (EETD 84)
15	0.872 (EETD 84)	0.891 (EETD 84)	0.897 (EETD 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	8.9	14.8
0	4355 (EETD 84)	7800 (EETD 84)	16500 (EETD 84)
15	41.1 (EETD 84)	83.6 (EETD 84)	265 (EETD 84)

4.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	8.9	14.8
0	4949 (EETD 84)	8686 (EETD 84)	18212 (EETD 84)
15	47.1 (EETD 84)	93.8 (EETD 84)	295 (EETD 84)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.9	14.8
0	N/M(EETD 84)	N/M(EETD 84)	N/M(EETD 84)
15	28.2(EETD 84)	27.5(EETD 84)	29.6(EETD 84)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.9	14.8
0	N/M(EETD 84)	N/M(EETD 84)	N/M(EETD 84)
15	12.4(EETD 84)	14.4(EETD 84)	17.1(EETD 84)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.9	14.8
0	N/M(EETD 84)	N/M(EETD 84)	N/M(EETD 84)
15	23.2(EETD 84)	23.7(EETD 84)	20.5(EETD 84)

6.0 POUR POINT (°C): -26(McCASLIN 79)

7.0 FLASH POINT (°C): 57(C.C.)(EETD 84)

8.0 REID VAPOUR PRESSURE: 15.5(EETD 84)

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (VOL %)		
	0	8.9	14.8
0	0.9(EETD 84)	1.0(EETD 84)	1.0(EETD 84)
15	1.0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (VOL %)		
	0	8.9	14.8
0	0.92(EETD 84)	0.9(EETD 84)	1.0(EETD 84)
15	1.0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.9	14.8
0	89.1(EETD 84)	84.9(EETD 84)	73.4(EETD 84)
15	88.5(EETD 85)	87.2(EETD 85)	86.1(EETD 85)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 6334.5 \theta \exp(6.3 - 4717.4/TK)/TK)}{(6334.5/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)

(Stiver 82)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	8.9	14.8
0	73 (EETD 85)	62 (EETD 85)	20 (EETD 85)
15	81 (EETD 85)	69 (EETD 85)	85 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	8.9	14.8
0	1 (EETD 85)	<1 (EETD 85)	0 (EETD 85)
15	2 (EETD 85)	5 (EETD 85)	2 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

WEATHERING (WT %)	SOLUBILITY (mg/L)
0	25.5 (BOBRA 83)
22.3	0.61 (BOBRA 83)

in fresh water @ 22°C: 8.40 (SUNTIO 86)
in fresh water: 12.10 (MACLEAN 88)
in seawater: 9.79 (MACLEAN 88)

15.0 TOXICITY:

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

WEATHERING (WT %)	48 hour LC ₅₀ (mg/L)
----------------------	------------------------------------

0	7.7 (BOBRA 83) >24.1 (MACLEAN 88) >8.4 (BOBRA 88)
22.3	>0.6 (BOBRA 83)

48 hour EC₅₀: 3.22 (MACLEAN 88)
2.2 (BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

48 hour EC₅₀: 8.68 (MACLEAN 88)
6.0 (BOBRA 88)

48 hour LC₅₀: 9.79 (MACLEAN 88)
6.7 (BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE
SPECTROSCOPY.

RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP
GC ANALYSIS.

16.0 SULPHUR (WT %): 1.23 (McCASLIN 79)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 4.36 (McCASLIN 79)

- 1.0 TYPE: LAGOTRECO CRUDE OIL.
1961 PRODUCTION SAMPLE FROM BACHAQUERO/PUERTO
MIRANDA EXPORT TERMINAL.
- 2.0 API GRAVITY: 27.3(PETRO-CAN 72)
- 3.0 DENSITY (g/mL):
@ 15 °C: 0.891(PETRO-CAN 72)
- 4.0 VISCOSITY:
4.1 DYNAMIC VISCOSITY:
4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 21 °C: 34.8(PETRO-CAN 72)
@ 38 °C: 17.5(PETRO-CAN 72)
- 5.0 INTERFACIAL TENSIONS:
- 6.0 POUR POINT (°C): -48(PETRO-CAN 72)
- 7.0 FLASH POINT:
- 8.0 VAPOUR PRESSURE:
- 9.0 DISTILLATION DATA:
- 10.0 EMULSION FORMATION TENDENCY & STABILITY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:
- 13.0 HYDROCARBON GROUP ANALYSIS:
ASPHALTENES 2.0(PETRO-CAN 72)
- 14.0 AQUEOUS SOLUBILITY:
- 15.0 TOXICITY:
- 16.0 SULPHUR (WT %): 1.41(PETRO-CAN 72)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 5.3(PETRO-CAN 72)

17.2 ASH (WT %): 0.026(PETRO-CAN 72)

17.3 SALT (lb/1000 bbl): 3(PETRO-CAN 72)

17.4 WATER (VOL %): 0.5(PETRO-CAN 72)

17.5 METALS (PPM): VANADIUM: 127(PETRO-CAN 72)
NICKEL: 12(PETRO-CAN 72)17.6 H₂S (WT %): NIL(PETRO-CAN 72)

17.7 WAX (WT %): 5.9(PETRO-CAN 72)

17.8 YIELD ON CRUDE:

	WT %	VOL %
GAS	0.34	0.48
BUT. GASOLINE TO 149 °C	11.22	13.62
KEROSINE 149-232 °C	11.21	12.38
GAS OIL 232-343 °C	19.16	19.76
RESIDUE above 343 °C	58.07	53.76

(PETRO-CAN 72)

1.0 TYPE: LA ROSA CRUDE OIL.

2.0 API GRAVITY: 25.3 (NELSON 69)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	0.923 (MACKAY 82A)	
5	0.921 (MACKAY 82A)	
10	0.917 (MACKAY 82A)	
15	0.914 (MACKAY 82A)	
20	0.911 (MACKAY 82A)	
25	0.908 (MACKAY 82A)	

NOTE: $DEN = 0.923 - 0.000617 T$

WHERE: DEN IS THE DENSITY OF FRESH OIL AT T (g/mL)
T IS OIL TEMPERATURE (°C) (MACKAY 82A)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING	
	(%)	
	0	
0	640 (MACKAY 82A)	
5	423 (MACKAY 82A)	
10	282 (MACKAY 82A)	
15	180 (MACKAY 82A)	
20	135 (MACKAY 82A)	
25	104 (MACKAY 82A)	

NOTE: $VISC = \exp((6040/(T+273)) - 15.7)$

WHERE: VISC IS THE VISCOSITY OF FRESH OIL AT T
(mPa.s)
T IS OIL TEMPERATURE (°C) (MACKAY 82A)

4.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP ($^{\circ}\text{C}$)	WEATHERING (%)
0	693 (MACKAY 82A)
5	459 (MACKAY 82A)
10	308 (MACKAY 82A)
15	197 (MACKAY 82A)
20	148 (MACKAY 82A)
25	115 (MACKAY 82A)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT ($^{\circ}\text{C}$): -30 (MACKAY 82A)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARON GROUP ANALYSIS (WT %):

SATURATES	66.1
AROMATICS	23.2
POLARS	4.48
ASPHALTENES	6.23 (MACKAY 82A)

14.0 AQUEOUS SOLUBILITY (mg/L):
in seawater: 19.97 (McAULIFFE 77)

15.0 TOXICITY:

16.0 SULPHUR (WT %): 1.76 (NELSON 69)

17.0 OTHERS:

17.1 WAX (WT %): 9.90 (MACKAY 82A)

- 1.0 TYPE: IPPL LIGHT SOUR BLEND.
BLEND OF LIGHT, MODERATELY LOW SULPHUR CRUDES
FROM FIELDS IN SASKATCHEWAN. SAMPLE FROM PIPELINE
BLEND DELIVERED TO TRAFALGAR REFINERY, SEPTEMBER
1970.
- 2.0 API GRAVITY: 35.9(PETRO-CAN 70)
- 3.0 DENSITY (g/mL):
@ 20 °C: 0.8415(PETRO-CAN 70)
- 4.0 VISCOSITY:
4.1 DYNAMIC VISCOSITY:
4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 21 °C: 6.80(PETRO-CAN 70)
@ 38 °C: 4.13(PETRO-CAN 70)
- 5.0 INTERFACIAL TENSIONS:
- 6.0 POUR POINT (°C): -12(PETRO-CAN 70)
- 7.0 FLASH POINT:
- 8.0 VAPOUR PRESSURE:
- 9.0 DISTILLATION DATA:
- 10.0 EMULSION FORMATION TENDENCY & STABILITY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:
- 13.0 HYDROCARBON GROUP ANALYSIS (WT %):
ASPHALTENES 1.0(PETRO-CAN 70)
- 14.0 AQUOEUS SOLUBILITY (mg/L);
in distilled water: 72.1(MURRAY 84)
- 15.0 TOXICITY:
- 16.0 SULPHUR (WT %): 1.0(PETRO-CAN 70)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 2.9 (PETRO-CAN 70)

17.2 METALS (PPM): VANADIUM: 7 (PETRO-CAN 70)
NICKEL: 5 (PETRO-CAN 70)

17.3 WATER (WT %): <0.01 (PETRO-CAN 70)

17.4 H₂S (WT %): 0.02 (PETRO-CAN 70)

17.5 WAX (WT %): 6.2 (PETRO-CAN 70)

17.6 YIELD ON CRUDE:

	----- WT % -----	----- VOL % -----
GAS	0.95	1.20
BUT. GASOLINE TO 149 °C	21.40	24.95
KEROSINE 149-232 °C	14.80	15.60
GAS OIL 232-343 °C	21.20	20.95
RESIDUE above 343 °C	41.65	37.30

(PETRO-CAN 70)

1.0 TYPE: LLOYDMINSTER CRUDE OIL, ALBERTA AND SASKATCHEWAN.

2.0 API GRAVITY: 20.7(AALUND 83A)

3.0 DENSITY (g/mL):
@ 21 °C: 0.9289(AALUND 83A)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 40 °C: 101.00(AALUND 83A)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -32.0(AALUND 83A)

7.0 FLASH POINT:

8.0 REID VAPOUR PRESSURE (kPa): 30.3(AALUND 83A)

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (PPM): 31,500(AALUND 83A)

17.0 OTHERS:

17.1 CON. CARBON (WT %): 9.18(AALUND 83A)

17.2 METALS (PPM): NICKEL: 52.70(AALUND 83A)
VANADIUM: 10.50(AALUND 83A)

17.3 YIELD ON CRUDE:

	<u>RANGE, °C</u>	<u>VOL %</u>
NAPHTHA	C ₅ - 190	19.50
KEROSINE	190 - 277	9.80
DISTILLATE	277 - 343	9.50
GAS OIL	343 - 565	25.20
RESIDUE	565 +	36.00

(AALUND 83A)

1.0 TYPE: LLOYDMINSTER CRUDE OIL.

2.0 API GRAVITY: 16.2(NELSON 69)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (WT %)		
	0	10	20
0	0.910 (MACKAY 82A)		
5	0.908 (MACKAY 82A)		
10	0.906 (MACKAY 82A)		
15	0.902 (MACKAY 82A)		
20	0.900 (MACKAY 82A)	0.923 (MACKAY 82A)	0.937 (MACKAY 82A)
25	0.897 (MACKAY 82A)		

NOTES: 0.90 @ ROOM TEMP (TWARDUS 80)

DEN = 0.910 - 0.00053 T

WHERE: DEN IS DENSITY OF FRESH OIL AT T (g/ml)

T IS OIL TEMPERATURE (°C) (MACKAY 82A)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

WEATHERING
(%)

TEMP (°C)	0
--------------	---

0	180 (MACKAY 82A) 126 (TWARDUS 80)
5	113 (MACKAY 82A)
10	80.1 (MACKAY 82A) 86.1 (TWARDUS 80)
15	62.7 (MACKAY 82A)
20	47.6 (MACKAY 82A) 52.3 (TWARDUS 80)
25	35.6 (MACKAY 82A)

NOTE: $VISC = \exp((5100/(T+273)) - 13.6)$
WHERE: VISC IS THE VISCOSITY OF FRESH OIL AT T
(mPa.s)
EXP IS EXPONENTIAL BASE e
T IS OIL TEMPERATURE (°C)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

WEATHERING
(%)

TEMP (°C)	0
--------------	---

0	198 (MACKAY 82A)
5	124 (MACKAY 82A)
10	88.4 (MACKAY 82A)
15	69.5 (MACKAY 82A)
20	52.9 (MACKAY 82A)
25	39.7 (MACKAY 82A)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm): @ ROOM TEMP: 25(TWARDUS 80)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

5.3 OIL-WATER (mN/m or dynes/cm):
@ ROOM TEMP: 31.2(TWARDUS 80)6.0 POUR POINT ($^{\circ}\text{C}$):WEATHERING
(WT %)POUR POINT
($^{\circ}\text{C}$)

-----	-----
0	-36(MACKAY 82A) -52(TWARDUS 80)
10	-36(MACKAY 82A)
20	-21(MACKAY 82A)
-----	-----

7.0 FLASH POINT ($^{\circ}\text{C}$): 11(O.C.)(TWARDUS 80)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME
PERCENTTEMP
($^{\circ}\text{C}$)

-----	-----
0	40
10	110
20	190
30	760
40	290
50	335
60	345
70	356
80	371
90	380
-----	-----

(TWARDUS 80)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

GROUP	WEATHERING (WT %)		
	0	10	20
SATURATES	68.4	66.0	62.7
AROMATICS	22.3	22.2	24.0
POLARS	3.75	3.18	3.36
ASPHALTENES	5.58	8.68	9.87

(MACKAY 82A)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 IN-SITY COMBUSTION OF FRESH OIL:

EASILY IGNITED, 6.1 VOL% RESIDUE (TWARDUS 80)

17.2 FIRE POINT (°C): 17 (TWARDUS 80)

17.3 WAX (WT %):

WEATHERING (WT %)	WAX (WT %)
0	5.47 (MACKAY 82A)
10	9.36 (MACKAY 82A)
20	11.1 (MACKAY 82A)

1.0 TYPE: VIRGIN CRANKCASE LUBRICATING OIL.
VIRGIN MOTOR OIL 10W/30.

2.0 API GRAVITY: 29(ESSO 73)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
0	0
0	0.8892(EETD 86)
15	0.8784(EETD 86)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
-28.9	20,000 to 30,500(ESSO 73)
-17.8	1,200 to 4,100(ESSO 73)
0	727.4(EETD 86)
15	224.5(EETD 86)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (%)
0	818.0(EETD 86)
15	255.6(EETD 86)
37.8	79 to 86(ESSO 73)
98.9	9.6 to 12.9(EESO 73)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

0	30.2 (EETD 86)
---	----------------

15	29.9 (EETD 86)
----	----------------

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

0	18.2 (EETD 86)
---	----------------

15	16.6 (EETD 86)
----	----------------

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

0	19.8 (EETD 86)
---	----------------

15	18.6 (EETD 86)
----	----------------

6.0 POUR POINT (°C): -37 (EESO 73)

7.0 FLASH POINT (°C): 199 (COC) (ESSO 73)
188 (COC) (ESSO 73)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	377	157
5	397	336
10	400	351
15	402	355
20	404	356
25	405	358
30	407	360
35	409	361
40	411	362
45	414	363
50	417	364
55	419	365
60	422	366
65	426	367
70	430	368
75	434	369
80	439	370
	(EETD 86)	(EETD 86)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
0	

0 1.0(EETD 86)

15 1.0(EETD 86)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
0	

0 1.0(EETD 86)

15 0.89(EETD 86)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	
0	58.6 (EETD 86)
15	72.2 (EETD 86)

11.0 WEATHERING:

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (%)
0	
0	82.2 (EETD 86)
15	69.7 (EETD 86)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (%)
0	
0	4.7 (EETD 86)
15	0 (EETD 86)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	73.7	
AROMATICS	25.4	
POLARS	0.9	
ASPHALTENES	0	(WATERS 78)

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22°C:	0.2 (SUNTIO 86)
in fresh water:	0.99 (MACLEAN 88)
in seawater:	1.43 (MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHIA MAGNA:

48 hour EC50: 0.30 (MACLEAN 88)

0.04 (BOBRA 88)

48 hour LC50: 0.38 (MACLEAN 88)

0.05 (BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

48 hour EC50: 0.08 (MACLEAN 88)

0.008 (BOBRA 88)

48 hour LC50: 0.44 (MACLEAN 88)

0.049 (BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE SPECTROSCOPY.

RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP GC ANALYSIS.

16.0 SULPHUR (WT %): 0.37 (EETD 86)

17.0 OTHERS:

17.1 COLOUR: 3.0, 4.0 (ESSO 73)

1.0 TYPE: USED CRANKCASE LUBRICATING OIL.
USED MOTOR OIL 10W/30.

2.0 API GRAVITY (15/15°C): 28.3(EETD 86)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	0.8945(EETD 86)
---	-----------------

15	0.8848(EETD 86)
----	-----------------

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	452.1(EETD 86)
---	----------------

15	175.2(EETD 86)
----	----------------

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	505.4(EETD 86)
---	----------------

15	198.0(EETD 86)
----	----------------

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

0 31.6 (EETD 86)

15 31.0 (EETD 86)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

0 24.2 (EETD 86)

15 21.0 (EETD 86)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

0 27.1 (EETD 86)

15 24.4 (EETD 86)

6.0 POUR POINT (°C): -36 (EETD 86)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
0	

0	1.0 (EETD 86)
---	---------------

15	1.0 (EETD 86)
----	---------------

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
0	

0	1.0 (EETD 86)
---	---------------

15	0.70 (EETD 86)
----	----------------

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	

0	57.9 (EETD 86)
---	----------------

15	72.8 (EETD 86)
----	----------------

11.0 WEATHERING:

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (%)
0	

0	16.2 (EETD 86)
---	----------------

15	12.3 (EETD 86)
----	----------------

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (%)
0	1.1 (EETD 86)
15	0 (EETD 86)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	86.3
AROMATICS	12.9
POLARS	0.8
ASPHALTENES	0 (WATERS 78)

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22°C:	0.6 (SUNTIO 86)
in fresh water:	19.1 (MACLEAN 88)
in seawater:	12.83 (MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHIA MAGNA:

48 hour EC50:	4.65 (MACLEAN 88)
	0.15 (BOBRA 88)
48 hour LC50:	4.87 (MACLEAN 88)
	0.16 (BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

48 hour EC50:	>12.8 (MACLEAN 88)
	>0.48 (BOBRA 88)
48 hour LC50:	>12.8 (MACLEAN 88)
	>0.48 (BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE SPECTROSCOPY.

RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP GC ANALYSIS.

16.0 SULPHUR (WT %): 0.29 (EETD 86)

17.0 OTHERS:

1.0 TYPE: EXTREME PRESSURE GEAR LUBRICATING OIL.
API 6L-5 SERVICE. SAE 140.

2.0 API GRAVITY: 14, 22, 25(ESSO 73)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
0	0
0	0.8925(EETD 86)
15	0.8827(EETD 86)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	0
0	4,060(EETD 86)
15	975(EETD 86)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (%)
0	0
0	4,549(EETD 86)
15	1,104(EETD 86)
37.8	432, 442, 710, 780(ESSO 73)
98.9	25 to 42.7(ESSO 73)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	--------------------

0	30.1(EETD 86)
---	---------------

15	29.7(EETD 86)
----	---------------

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	--------------------

0	3.6(EETD 86)
---	--------------

15	2.8(EETD 86)
----	--------------

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	--------------------

0	4.2(EETD 86)
---	--------------

15	3.4(EETD 86)
----	--------------

6.0 POUR POINT (°C): -7, -9, -15(ESSO 73)

7.0 FLASH POINT (°C): 193, 199, 266(ESSO 73)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
0	

0	1.0 (EETD 86)
---	---------------

15	1.0 (EETD 86)
----	---------------

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
0	

0	1.0 (EETD 86)
---	---------------

15	1.0 (EETD 86)
----	---------------

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	

0	30.6 (EETD 86)
---	----------------

15	57.9 (EETD 86)
----	----------------

11.0 WEATHERING:

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP		WEATHERING
(°C)		(%)
	0	
0	84.1 (EETD 86)	
15	59.9 (EETD 86)	

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP		WEATHERING
(°C)		(%)
	0	
0	23.6 (EETD 86)	
15	21.6 (EETD 86)	

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22°C: 0.8 (SUNTIO 86)
in fresh water: 2.3 (MACLEAN 88)
in seawater: 1.66 (MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHIA MAGNA:

48 hour EC50: 0.92 (MACLEAN 88)
0.31 (BOBRA 88)

48 hour LC50: >2.38 (MACLEAN 88)
>0.80 (BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

48 hour EC50: >1.66 (MACLEAN 88)
>0.64 (BOBRA 88)

48 hour LC50: >1.66 (MACLEAN 88)
>0.64 (BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE SPECTROSCOPY.

RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP GC ANALYSIS.

16.0 SULPHUR (WT %): 1.10 (EETD 86)

17.0 OTHERS:

1.0 TYPE: MARINE DIESEL FUEL.

NOTE: DATA FROM (BURNETT 85) ARE MEAN VALUES FOR
WORLDWIDE SAMPLES OF COMMERCIAL MARINE FUELS.

2.0 API GRAVITY: 31.3(BURNETT 85)

3.0 DENSITY:

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm^2/s):
@ 40°C: 6.1(BURNETT 85)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): 23(BURNETT 85)

7.0 FLASH POINT (°C): 209(BURNETT 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
-----	-----
IBP	366
FBP	800
-----	-----

(BURNETT 85)
(ASTM D 86)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (VOL %):

AROMATICS	43.3(BURNETT 85)
ASPHALTENES	0.01(BURNETT 85)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 1.12(BURNETT 85)

17.0 OTHERS:

17.1 METALS (PPM):

COPPPER	0.4
SODIUM	1.2
CALCIUM	0.8
VANADIUM	5 (BURNETT 85)

1.0 TYPE: MARINE GAS OIL FUEL.

NOTE: DATA FROM (BURNETT 85) ARE MEAN VALUES FOR
WORLDWIDE SAMPLES OF COMMERCIAL MARINE FUELS.

3.0 API GRAVITY: 34.2 (BURNETT 85)

3.0 DENSITY:

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm^2/s):
@ 40°C: 3.71 (BURNETT 85)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): 12 (BURNETT 85)

7.0 FLASH POINT (°C): 178 (BURNETT 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
-------------------	---------------------

IBP	399
-----	-----

FBP	689
-----	-----

(BURNETT 85)
(ASTM D 86)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (VOL %):

AROMATICS 38.2 (BURNETT 85)

ASPHALTENES 0.00 (BURNETT 85)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.42 (BURNETT 85)

17.0 OTHERS:

17.1 CLOUD POINT ($^{\circ}\text{C}$): 30 (BURNETT 85)

17.2 METALS (PPM):

COPPPER 0.4

SODIUM 1.2

CALCIUM 0.8

VANADIUM <5 (BURNETT 85)

17.3 APPEARANCE: CLEAR AND BRIGHT (BURNETT 85)

1.0 TYPE: HEAVY MARINE GAS OIL FUEL.

NOTE: DATA FROM (BURNETT 85) ARE MEAN VALUES FOR
WORLDWIDE SAMPLES OF COMMERCIAL MARINE FUELS.

2.0 API GRAVITY: 32.0(BURNETT 85)

3.0 DENSITY:

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm^2/s):
@ 40°C: 5.8(BURNETT 85)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): 24(BURNETT 85)

7.0 FLASH POINT (°C): 210(BURNETT 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
-----	-----
IBP	425
FBP	723
-----	-----

(BURNETT 85)
(ASTM D 86)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (VOL %):

AROMATICS	40.6(BURNETT 85)
ASPHALTENES	0.00(BURNETT 85)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.5(BURNETT 85)

17.0 OTHERS:

17.1 METALS (PPM):

COPPPER 0.4

SODIUM 1.1

CALCIUM 0.9

VANADIUM <5 (BURNETT 85)

1.0 TYPE: MARINE INTERIMEDIATE FUEL OIL.

NOTE: DATA FROM (BURNETT 85) ARE MEAN VALUES FOR
WORLDWIDE SAMPLES OF COMMERCIAL MARINE FUELS.

2.0 API GRAVITY: 14.6(BURNETT 85)

3.0 DENSITY:

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm^2/s):

@ 40°C: 198(BURNETT 85)

@ 100°C: 25.0(BURNETT 85)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): 42(BURNETT 85)

7.0 FLASH POINT (°C): 183(BURNETT 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (VOL %):

ASPHALTENES 10.3(BURNETT 85)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 2.7(BURNETT 85)

17.0 OTHERS:

17.1 METALS (PPM):

COPPPER 0.5

SODIUM 33

CALCIUM 15

VANADIUM 150 (BURNETT 85)

- 1.0 TYPE: MAYA CRUDE OIL, MEXICO.
SAMPLE FROM CANTARELL COMPLEX, GULF OF CAMPECHE.
SAMPLE RECEIVED AUGUST 1980 FROM ASHLAND OIL, INC.
- 2.0 API GRAVITY: 21.7 (PETRO-CAN 81)
- 3.0 DENSITY (g/mL):
@ 15 °C: 0.923 (PETRO-CAN 81)
- 4.0 VISCOSITY:
4.1 DYNAMIC VISCOSITY:
4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 10 °C: 522 (PETRO-CAN 81)
@ 20 °C: 267 (PETRO-CAN 81)
@ 40 °C: 69.8 (PETRO-CAN 81)
- 5.0 INTERFACIAL TENSIONS:
- 6.0 POUR POINT (°C): -15 (PETRO-CAN 81)
- 7.0 FLASH POINT:
- 8.0 VAPOUR PRESSURE:
- 9.0 DISTILLATION DATA:
- 10.0 EMULSION FORMATION TENDENCY & STABILITY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:
- 13.0 HYDROCARBON GROUP ANALYSIS:
ASPHALTENES 8.5 (PETRO-CAN 81)
- 14.0 AQUEOUS SOLUBILITY:
- 15.0 TOXICITY:
- 16.0 SULPHUR (WT %): 3.40 (PETRO-CAN 81)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 11.6(PETRO-CAN 81)

17.2 METALS (PPM):VANADIUM: 271(PETRO-CAN 81)
NICKEL: 53(PETRO-CAN 81)17.3 H₂S (WT %): NIL(PETRO-CAN 81)

17.4 WAX (WT %): 2(PETRO-CAN 81)

17.5 YIELD ON CRUDE:

	WT %	VOL %
GAS	0.8	0.9
BUT. GASOLINE TO 149 °C	9.65	12.45
KEROSINE 149-232 °C	9.75	11.35
GAS OIL 232-343 °C	14.65	15.75
RESIDUE above 343 °C	65.15	59.55

(PETRO-CAN 81)

1.0 TYPE: MAYOGIAK CRUDE OIL, BEAUFORT SEA.

2.0 API GRAVITY:

3.0 DENSITY (g/mL):

For $F < 12\%$ & T at 20 deg C:

$DEN = 0.863686 + 0.001809 F$

where: DEN is density of oil at T and F (g/mL)

F is percent of oil weathered

T is oil temperature ($^{\circ}\text{C}$)

TEMP ($^{\circ}\text{C}$)	WEATHERING (%)		
	0	4	12
20	0.8625 (ENGELHARDT 84)	0.8727 (ENGELHARDT 84)	0.8848 (ENGELHARDT 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP ($^{\circ}\text{C}$)	WEATHERING (%)		
	0	4	12
-10	752.1 (ENGELHARDT 84)	1023 (ENGELHARDT 84)	D.F. (ENGELHARDT 84)
0	67.27 (ENGELHARDT 84)	98.35 (ENGELHARDT 84)	414.3 (ENGELHARDT 84)
15	17.04 (ENGELHARDT 84)	29.88 (ENGELHARDT 84)	56.37 (ENGELHARDT 84)
25	9.702 (ENGELHARDT 84)	18.33 (ENGELHARDT 84)	30.41 (ENGELHARDT 84)

NOTE: D.F.- DID NOT FLOW

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C):

WEATHERING
(%)POUR POINT
(°C)

0

-30 (ENGELHARDT 84)

4

-26 (ENGELHARDT 84)

12

-18 (ENGELHARDT 84)

7.0 FLASH POINT (°C):

WEATHERING
(%)FLASH POINT
(°C)

0

-12 (ENGELHARDT 84)

4

47 (ENGELHARDT 84)

12

66 (ENGELHARDT 84)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

PERCENT
CONDENSED
(VOL %)WEATHERING
(%)

INITIAL

-2

55

146

(ENGELHARDT 84) (ENGELHARDT 84) (ENGELHARDT 84)

50

318

336

376

(ENGELHARDT 84) (ENGELHARDT 84) (ENGELHARDT 84)

FINAL

555

554

558

(ENGELHARDT 84) (ENGELHARDT 84) (ENGELHARDT 84)

FINAL

94 %

88 %

83 %

VOL (ENGELHARDT 84) (ENGELHARDT 84) (ENGELHARDT 84)

CONT'D

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 FIRE POINT:

WEATHERING
(%)

FIRE POINT
(°C)

0

-12 (ENGELHARDT 84)

4

64 (ENGELHARDT 84)

12

76 (ENGELHARDT 84)

1.0 TYPE: MCARTHUR RIVER CRUDE OIL, OFFSHORE COOK INLET, ALASKA.

2.0 API GRAVITY: 35.4 (COLEMAN 78)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.848 (COLEMAN 78)

4.0 VISCOSITY (Saybolt Universal seconds):
@ 25 °C: 116 (COLEMAN 78)
@ 37.8 °C: 85 (COLEMAN 78)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -7 (COLEMAN 78)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

CUT TEMPERATURE (°C)	VOLUME PERCENT
-----	-----
26	IBP
50	2.4
75	4.9
100	10.8
125	16.9
150	22.0
175	27.2
200	32.1
225	37.2
250	42.4
275	47.4
-----	-----

(COLEMAN 78)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.08 (COLEMAN 78)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 2.1(COLEMAN 78)

17.2 NITROGEN (WT %): 0.137(COLEMAN 78)

17.3 COLOUR: BROWNISH BLACK(COLEMAN 78)

1.0 TYPE: MENEMOTA CRUDE OIL, 1982.

2.0 API GRAVITY: 19.7(PETRO-CAN 82)

3.0 DENSITY (g/mL):
@ 15 °C: 0.936(PETRO-CAN 82)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 40 °C: 91.7(PETRO-CAN 82)
@ 100 °C: 13.1(PETRO-CAN 82)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): <-30(PETRO-CAN 82)

7.0 FLASH POINT:

8.0 REID VAPOUR PRESSURE (kPa): <0.15(PETRO-CAN 82)

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMP (°C)
IBP	62
10	180
20	255
29	300

(ASTM D 86) (PETRO-CAN 82)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:
ASPHALTENES 5.7 (PETRO-CAN 82)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 2.32(PETRO-CAN 82)

17.0 OTHERS:

17.1 ASH (WT %): 0.07 (PETRO-CAN 82)

17.2 METALS (PPM): VANADIUM: 390 (PETRO-CAN 82)
NICKEL: 49 (PETRO-CAN 82)
SODIUM: 1 (PETRO-CAN 82)
IRON: <1 (PETRO-CAN 82)
COPPER: <1 (PETRO-CAN 82)
CHROMIUM: 0 (PETRO-CAN 82)

17.3 H₂S (WT %): <1 (PETRO-CAN 82)

17.4 WAX (WT %): 2.51 (PETRO-CAN 82)
CONGEALING POINT OF WAX (°C): 58.5 (PETRO-CAN 82)

17.5 ACID NUMBER (mgKOH/g): 1.03 (PETRO-CAN 82)

17.6 UOP K CHARACTERIZATION FACTOR: 11.7 (PETRO-CAN 82)

17.7 YIELD ON CRUDE:

		----- WT % -----	----- VOL % -----
STRAIGHT-RUN GASOLINE			
UP TO 65 °C		1.78	2.64
NAPHTHA	65-150 °C	5.70	7.15
KEROSINE	150-250 °C	10.46	11.88
GAS OIL	250-370 °C	18.28	19.07
RESIDUE	above 370 °C	63.79	59.26
		-----	-----
		(PETRO-CAN 82)	

1.0 TYPE: MIDDLE GROUND SHOAL CRUDE OIL, OFFSHORE COOK INLET,
ALASKA.

2.0 API GRAVITY: 41.5(COLEMAN 78)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.818(COLEMAN 78)

4.0 VISCOSITY (Saybolt Universal seconds):
@ 25 °C: 47(COLEMAN 78)
@ 37.8 °C: 43(COLEMAN 78)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): <-15(COLEMAN 78)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

CUT TEMPERATURE (°C)	VOLUME PERCENT
-----	-----
26	IBP
50	2.1
75	5.9
100	13.4
125	22.8
150	32.1
175	37.4
200	42.1
225	47.8
250	53.3
275	58.1
-----	-----

(COLEMAN 78)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.07(COLEMAN 78)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 1.5(COLEMAN 78)

17.2 NITROGEN (WT %): 0.047(COLEMAN 78)

17.3 COLOUR: BROWNISH BLACK(COLEMAN 78)

- 1.0 TYPE: IPPL MIXED SOUR BLEND.
BLEND OF LIGHT, MODERATELY LOW SULPHUR CRUDE
FROM FIELDS IN ALBERTA AND SASKATCHEWAN
SAMPLE FROM PIPELINE BLEND DELIVERED TO
TRAFALGAR REFINERY, DECEMBER 1974.
- 2.0 API GRAVITY: 38.6(PETRO-CAN 75)
- 3.0 DENSITY (g/mL):
@ 20 °C: 0.828(PETRO-CAN 75)
- 4.0 VISCOSITY:
- 5.0 INTERFACIAL TENSIONS:
- 6.0 POUR POINT (°C): -6(PETRO-CAN 75)
- 7.0 FLASH POINT:
- 8.0 VAPOUR PRESSURE:
- 9.0 DISTILLATION DATA:
- 10.0 EMULSION FORMATION TENDENCY & STABILITY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:
- 13.0 HYDROCARBON GROUP ANALYSIS (WT %):
ASPHALTENES 0.3(PETRO-CAN 75)
- 14.0 AQUEOUS SOLUBILITY:
- 15.0 TOXICITY:
- 16.0 SULPHUR (WT %): 0.46(PETRO-CAN 75)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 1.9 (PETRO-CAN 75)

17.2 METALS: VANADIUM: <2 (PETRO-CAN 75)
NICKEL: 2 (PETRO-CAN 75)

17.3 WATER (WT %): NIL (PETRO-CAN 75)

17.4 YIELD ON CRUDE:

	WT %	VOL %
GAS	1.0	1.55
BUT. GASOLINE TO 149 °C	19.55	22.45
KEROSINE 149-232 °C	16.1	16.85
GAS OIL 232-343 °C	21.65	21.35
RESIDUE above 343 °C	41.7	37.8

(PETRO-CAN 75)

1.0 TYPE: MURBAN CRUDE OIL.

2.0 API GRAVITY:

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (WT %)		
	0	10	20
0	0.838 (MACKAY 82A)		
5	0.832 (MACKAY 82A)		
10	0.830 (MACKAY 82A)		
15	0.828 (MACKAY 82A)		
20	0.824 (MACKAY 82A)	0.842 (MACKAY 82A)	0.855 (MACKAY 82A)
25	0.822 (MACKAY 82A)		

NOTES: $DEN = 0.837 - 0.000606 T$

WHERE: DEN IS OIL DENSITY OF AT T (g/mL)

T IS OIL TEMPERATURE (°C) (MACKAY 82A)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	

0	40.1 (MACKAY 82A)
5	22.1 (MACKAY 82A)
10	11.9 (MACKAY 82A)
15	6.97 (MACKAY 82A)
20	4.37 (MACKAY 82A)
25	3.90 (MACKAY 82A)

NOTES: VISC = EXP((7960/(T+273)) - 25.6)

WHERE: VISC IS THE VISCOSITY OF FRESH OIL AT T
(mPa.s)

EXP IS EXPONENTIAL BASE e

T IS OIL TEMPERATURE (°C) (MACKAY 82A)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (%)
0	

0	47.9 (MACKAY 82A)
5	26.6 (MACKAY 82A)
10	14.3 (MACKAY 82A)
15	8.42 (MACKAY 82A)
20	5.30 (MACKAY 82A)
25	4.74 (MACKAY 82A)

5.0 INTERFACIAL TENSIONS:

5.1 OIL-AIR (mN/m or dynes/cm):

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (WT %)		
	0	10	20
?	16.3 (MACKAY 82A)	16.4 (MACKAY 82A)	14.3 (MACKAY 82A)

6.0 POUR POINT ($^{\circ}\text{C}$):WEATHERING
(WT %)POUR POINT
($^{\circ}\text{C}$)

0	-3 (MACKAY 82A)
10	0 (MACKAY 82A)
20	15 (MACKAY 82A)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

GROUP	WEATHERING (WT %)		
	0	10	20
SATURATES	81.4	76.3	74.3
AROMATICS	16.6	17.5	19.4
POLARS	1.27	2.05	2.12
ASPHALTENES	0.75	4.14	4.20

(MACKAY 82A)

14.0 AQUEOUS SOLUBILITY (mg/L):

in double-distilled water @ room temp: 28.62 (BOBRA 83)

in seawater: 27.87 (MCAULIFFE 77)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

48 hour LC_{50} : 7.4 (BOBRA 83)

16.0 SULPHUR:

17.0 OTHERS:

17.1 WAX (WT %):

WEATHERING
(WT %)WAX
(WT %)-----
0-----
5.68 (MACKAY 82A)

10

6.83 (MACKAY 82A)

20

7.45 (MACKAY 82A)

1.0 TYPE: NAPHTHA, MINERAL SPIRITS.

Synonyms: white spirits, petroleum spirits, light petrol, Stoddard solvent, Varsol and Shell Sol 140. (TIPS 85)

2.0 API GRAVITY: 48.8 to 50.6(ESSO 73)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
0	0
0	0.8040(EETD 86)
15	0.7930(EETD 86)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	0
0	1.4(EETD 86)
15	1.1(EETD 86)
25	0.85 to 1.165(ESSO 73)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (%)
0	0
0	1.78(EETD 86)
15	1.43(EETD 86)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

0	26.2 (EETD 86)
---	----------------

15	24.7 (EETD 86)
----	----------------

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

0	43.2 (EETD 86)
---	----------------

15	43.1 (EETD 86)
----	----------------

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

0	44.4 (EETD 86)
---	----------------

15	43.9 (EETD 86)
----	----------------

6.0 POUR POINT (°C): -69 (EETD 86)

7.0 FLASH POINT (°C): 41 to 57 (T.C.C.) (ESSO 73)
41 to 138 (T.C.C.) (GULF TS 83)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

BOILING RANGE (°C):

MINERAL SPIRITS: 150 to 200 (NIOSH 77)

STODDARD SOLVENT: 160 to 210 (NIOSH 77)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
0	0

0	0 (EETD 86)
---	-------------

15	0 (EETD 86)
----	-------------

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
0	0

0	0 (EETD 86)
---	-------------

15	0 (EETD 86)
----	-------------

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	0

0	N/M (EETD 86)
---	---------------

15	N/M (EETD 86)
----	---------------

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (%):

	MINERALS SPIRITS	STODDARD SOLVENT
	C ₉ -C ₁₀ hydrocarbons	C ₉ -C ₁₁ hydrocarbons
composed of		
PARAFFINS	30 to 65	30 to 50
NAPHTHENES	15 to 55	30 to 40
AROMATICS	10 to 30	10 to 20

(NIOSH 77)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (PPM): 1 (ESSO 73)

17.0 OTHERS:

17.1 COLOUR: +30(ESSO 73)

1.0 TYPE: NAPHTHA, PETROLEUM ETHER.

Synonyms: benzin, benzine, petroleum benzin, canadol,
light ligroin, Skellysolve. (TIPS 85)

2.0 API GRAVITY (15/15°C): 89.3 (EETD 86)

3.0 DENSITY (g/mL):

TEMP (°C)		WEATHERING (%)
0	0.6547 (EETD 86)	
15	0.6404 (EETD 86)	

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)		WEATHERING (%)
0	0.30 (EETD 86)	
15	0.25 (EETD 86)	

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)		WEATHERING (%)
0	0.45 (EETD 86)	
15	0.39 (EETD 86)	

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)		WEATHERING (%)
0	18.2 (EETD 86)	
15	17.5 (EETD 86)	

5.2 OIL-SEAWATER (mN/m or dynes/cm):

WEATHERING

TEMP

(8)

(°C)

O

O

44.8 (EETD 86)

15

43.8 (EETD 86)

5.3 OIL-WATER (mN/m or dynes/cm):

WEATHERING

TEMP

(8)

(°C)

O

O

45.5 (EETD 86)

15

44.4 (EETD 86)

6.0 POUR POINT:

7.0 FLASH POINT (°C): -49(CCD 77)
 <-18(NFPA 78)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

BOILING POINT/DISTILLATION RANGE (°C): 30 to 60 (CCD 77)
35 to 60 (NFPA 78)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

WEATHERING

TEMP (°C)	(%)
--------------	-------

0	0 (EETD 86)
---	-------------

15	0 (EETD 86)
----	-------------

10.2 EMULSION STABILITY:

WEATHERING

TEMP (°C)	(%)
--------------	-------

0	0 (EETD 86)
---	-------------

15	0 (EETD 86)
----	-------------

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

WEATHERING

TEMP (°C)	(%)
--------------	-------

0	N/A (EETD 86)
---	---------------

15	N/A (EETD 86)
----	---------------

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

primarily pentane and i-hexane, no aromatics (NIOSH 77)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 AUTOIGNITION TEMPERATURE ($^{\circ}\text{C}$): 288(CCD 77) (NFPA 78)

17.2 FREEZING POINT ($^{\circ}\text{C}$): -73(CCD 77)

17.3 VAPOUR DENSITY: 2.5(NIOSH 77)

17.4 FLAMMABILITY LIMITS (VOL %):

UPPER: 5.9(NFPA 78)

LOWER: 1.1(NFPA 78)

1.0 TYPE: NAPHTHA, RUBBER SOLVENT.

Synonyms: benzine, lacquer diluent, light spirits,
Iosol and Tolu-Sol.

2.0 API GRAVITY: 58.7 to 67.5(ESSO 73)

3.0 DENSITY: 0.711 to 0.7440(ESSO 73)

0.74 to 0.771(ISH 77)

0.7038 to 0.7398(GULF TS 83)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

WEATHERING

TEMP

(°C)

0

(VOL %)

25

0.40 to 0.50(EETD 86)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT (°C): -23 to -4(T.C.C.)(ESSO 73)

-5, -4(ISH 77)

<20(GULF TS 83)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

RUBBER SOLVENT: 45 to 125(NIOSH 77)

LIGHT SPIRITS: 95 to 110(PPH 60; MPT 75; ASTM 62)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (%):

composed of C₅ to C₈ hydrocarbons

PARAFFINS 70 to 90

NAPHTHALENES 11 to 22

AROMATICS 9 to 22

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (PPM): 1(ESSO 73)

17.0 OTHERS:

17.1 ANILINE POINT($^{\circ}$ C): 50 to 54(ESSO 73)

1.0 TYPE: VARNISH MAKERS AND PAINTERS NAPHTHA. VM&P NAPHTHA.
Synonyms: benzine, naphtha 76, ligroin, high boiling
petroleum ether, light naphtha, dry-cleaning naphtha
and spotting naphtha. (TIPS 85)

2.0 API GRAVITY:

3.0 DENSITY:

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	
---	--

20	19 to 23 (CHRIS 78)
----	---------------------

5.2 OIL-SEAWATER (mN/m or dynes/cm):

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	
---	--

?	39 to 51 (CHRIS 78)
---	---------------------

6.0 POUR POINT:

7.0 FLASH POINT (°C): -2 to 29 (NFPA 78)
-8, -7 (ALLIANCE 80)
-13, -7 (CHRIS 78)
<20 (T.C.C.) (GULF TS 83)
12 (T.C.C.) (ESSO 73)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

BOILING RANGE: 100 to 140 (PPH 60; MPT 75; ASTM 62)
95 to 160 (NIOSH 77)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (%):

composed of C₇ to C₁₁ hydrocarbons

PARAFFINS 45 to 60

NAPHTHALENES 30 to 45

AROMATICS 5 to 13 (NIOSH 77)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 AUTOIGNITION TEMPERATURE (°C): 232(NFPA 78)

17.2 VAPOUR DENSITY: 4.3, 4.1(NFPA 78)

17.3 FLAMMABILITY LIMIT (VOL %):

LOWER: 0.9(NFPA 78)(ALLIANCE 80)(CHRIS 78)

1.0(NFPA 78)

UPPER: 6.0(NFPA 78)(ALLIANCE 80)

6.7(NFPA 78)(CHRIS 78)

17.4 BURNING RATE (mm/min.): 4.4(CHRIS 78)

1.0 TYPE: NEKTORALIK K-59 CRUDE OIL. BEAUFORT SEA, CANADA.

2.0 API GRAVITY: 26.1(DOME 84)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.8541(DOME 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

WEATHERING
(%)

TEMP
(°C)

0

10 21(DOME 84)

20 12.90(DOME 84)

30 9.80(DOME 84)

40 6.78(DOME 84)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): 2.8(DOME 84)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME
PERCENT

TEMP
(°C)

5	121
10	160
15	198
20	238
25	254
30	277
35	287
40	298
45	304
50	312
55	321
60	338
65	342
70	343(DOME 84)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.17(DOME 84)

17.0 OTHERS:

17.1 TOTAL SALTS (g/m³): 0.5992(DOME 84)

1.0 TYPE: NEKTORALIK K-59A CRUDE OIL. BEAUFORT SEA, CANADA.

2.0 API GRAVITY: 39.9(DOME 84)

3.0 DENSITY (g/mL): 0.8257(DOME 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):
WEATHERING

TEMP (°C) 0 (%)

20 1.396(DOME 84)

30 1.205(DOME 84)

40 1.020(DOME 84)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

WEATHERING

TEMP (°C) 0 (%)

20 1.695(DOME 84)

30 1.475(DOME 84)

40 1.260(DOME 84)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -39(DOME 84)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMP (°C)
5	90
10	101
15	111
20	120
25	131
30	140
35	153
40	170
45	186
50	201
55	217
60	231
65	243
70	254
75	267
80	280
85	294
90	313
95	323 (DOME 84)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.0067 (DOME 84)

17.0 OTHERS:

17.1 TOTAL SALTS (g/m³): 32.075 (DOME 84)

1.0 TYPE: NERLERK M-98A CRUDE OIL. BEAUFORT SEA, CANADA.

2.0 API GRAVITY: 22.3(DOME 84)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.9227(DOME 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):
WEATHERING

TEMP (°C)	(¢)
--------------	----------

0	
20	89.6(DOME 84)

30	50.3(DOME 84)
----	---------------

40	30.0(DOME 84)
----	---------------

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: NERLERK M-98B CRUDE OIL. BEAUFORT SEA, CANADA.

2.0 API GRAVITY: 24.3(DOME 84)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.9114(DOME 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
0	
20	54.3(DOME 84)
30	30.6(DOME 84)
40	19.4(DOME 84)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: NERLERK M-98C CRUDE OIL. BEAUFORT SEA, CANADA.

2.0 API GRAVITY: 26.4(DOME 84)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.8981(DOME 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):
WEATHERING

TEMP (°C)	(%)
--------------	-------

0

20 12.7 (DOME 84)

30 8.84 (DOME 84)

40 6.34 (DOME 84)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: NINIAN CRUDE OIL.

2.0 API GRAVITY: 37.0(LYNCH 81)

3.0 DENSITY (g/mL):
@ 16 °C: 0.8393(LYNCH 81)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 50 °C: 7.5(LYNCH 81)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): 6(LYNCH 81)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

WEIGHT PERCENT	TEMP (°C)
-----	-----
6.7	5 TO 100
12.7	100 TO 160
12.1	160 TO 250
19.7	250 TO 350
48.8	>350(LYNCH 81)
-----	-----

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):
ASPHALTENES 0.5(LYNCH 81)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 WAX (WT %): 8(LYNCH 81)

1.0 TYPE: NORMAN WELLS CRUDE OIL. NORTHWEST TERRITORIES, CANADA.

2.0 API GRAVITY (15/15°C): 38.4 (EETD 84)

3.0 DENSITY (g/mL):

For Fw < 20.4 % & T between 0 and 25 °C:

DEN = 0.846161 + 0.001732 Fw - 0.000783 T

where: DEN is density of oil at T and Fw (g/mL)

Fw is weight percent of oil weathered

T is oil temperature (°C)

TEMP (°C)	WEATHERING (WT %)		
	0	12	20.4
0	0.845 (MACKAY 82A) 0.840 (MACKAY 75) 0.8581 (EETD 85)	0.864 (MACKAY 75)	0.881 (MACKAY 75)
5	0.841 (MACKAY 82A)		
10	0.839 (MACKAY 82A)		
15	0.832 (EETD 84) 0.834 (MACKAY 82A) 0.832 (MACKAY 75)	0.855 (MACKAY 75)	0.873 (MACKAY 75)
20	0.832 (MACKAY 82A)		
25	0.829 (MACKAY 82A)	0.844 (MACKAY 75)	0.863 (MACKAY 75)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

$$\text{VISC} = \exp(2.26 - 2461.7 T / (273(T+273)))$$

where: VISC is dynamic viscosity of oil at T (mPa.s)

exp is exponential base e

T is oil temperature (°C)

TEMP (°C)	WEATHERING (WT %)		
	0	20.4	42.3
-25	22 (MACKAY 75)	99 (MACKAY 75)	
-15	18 (MACKAY 75)	69 (MACKAY 75)	
0	8.76 (MACKAY 82A) 14.2 (TWARDUS 80) 11 (MACKAY 75)	40 (MACKAY 75)	300 (MACKAY 75)
5	7.11 (MACKAY 82A)		
10	5.81 (MACKAY 82A) 8.68 (TWARDUS 80) 9 (MACKAY 75)	28 (MACKAY 75)	180 (MACKAY 75)
15	5.05 (MACKAY 82A) 7.9 (MACKAY 75)	25 (MACKAY 75)	150 (MACKAY 75)
20	4.39 (MACKAY 82A) 5.9 (TWARDUS 80)		
25	3.93 (MACKAY 82A) 6.1 (MACKAY 75)	15 (MACKAY 75)	80 (MACKAY 75)

4.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (°C)	WEATHERING (WT %)		
	0	20.4	42.3
0	10.37 (MACKAY 82A) 13.1 (MACKAY 75)	46 (MACKAY 75)	34 (MACKAY 75)
5	8.45 (MACKAY 82A)		
10	6.93 (MACKAY 82A)		
15	6.06 (MACKAY 82A) 9.5 (MACKAY 75)	29 (MACKAY 75)	172 (MACKAY 75)
20	5.28 (MACKAY 82A)		
25	4.74 (MACKAY 82A)	18 (MACKAY 75)	93 (MACKAY 75)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)		
	0	20.4	36.7
0	24.9 (EETD 84)		
5	23.7 (MACKAY 75)	28.2 (MACKAY 75)	29.8 (MACKAY 75)
15	23.6 (EETD 84)		
25	22.7 (MACKAY 75)	27 (MACKAY 75)	28.5 (MACKAY 75)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)	
	0	
0	16.5 (EETD 84)	
15	16.4 (EETD 84)	

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	20.5 (EETD 85)
15	20.1 (EETD 85)

6.0 POUR POINT:

WEATHERING (WT %)	POUR POINT (°C)
0	<-50 (MACKAY 82A) -85 (TWARDUS 80) -50 (MACKAY 75)
10	<-50 (MACKAY 82A)
12	-34 (MACKAY 75)
20	<-50 (MACKAY 82A)
20.4	-26 (MACKAY 75)
36.7	-12 (MACKAY 75)

NOTES: Pour Point = $-51 + 1.50 E - 0.012 E^2$
WHERE: E = WT % EVAPORATED (MACKAY 75)

7.0 FLASH POINT (°C): 3 (C.C.) (EETD 84)

8.0 REID VAPOUR PRESSURE (kPa): 36.2 (EETD 84)

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
0	60
10	118
20	145
30	174
40	223
50	280

DATA OBTAINED FROM A CURVE(MACKAY 75)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
0	

0 (EETD 84)

15 0 (EETD 84)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
0	

0 (EETD 84)

15 0 (EETD 84)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	

0 N/A (EETD 84)

15 N/A (EETD 84)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 5315.8 \theta \exp(6.3 - 3911.9/TK)/TK)}{(5315.8/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (EETD 84)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
 OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP ($^{\circ}C$)	WEATHERING (%)	
	0	
0	79 (EETD 85)	
15	75 (EETD 85)	

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP ($^{\circ}C$)	WEATHERING (%)	
	0	
0	5 (EETD 85)	
15	8 (EETD 85)	

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

GROUP	WEATHERING (WT %)		
	0	10	20
SATURATES	85.1(MACKAY 82A) 86.3(EETD 86)	82.2(MACKAY 82A)	80.0(MACKAY 82A)
AROMATICS	11.4(MACKAY 82A) 11.1(EETD 86)	11.5(MACKAY 82A)	13.1(MACKAY 82A)
POLARS	2.32(MACKAY 82A) 1.6(EETD 86)	3.45(MACKAY 82A)	4.13(MACKAY 82A)
ASPHALTENES	1.13(MACKAY 82A) 1.0(EETD 86)	2.88(MACKAY 82A)	3.20(MACKAY 82A)

14.0 AQUEOUS SOLUBILITY (mg/L):

WEATHERING (WT %)	SOLUBILITY (mg/L)
0	32.3(MACKAY 75) 32.3(BOBRA 83) 33.5 @ 22°C in distilled water(MAIJANEN 84) 33.0 @ 20°C in distilled water(MAIJANEN 84) 28.0 @ 20 °C in salt water(MAIJANEN 84) 30.0 @ 5°C in distilled water(MAIJANEN 84) 25.5 @ 5°C in salt water(MAIJANEN 84) 60.1(MURRAY 84) 25.5 @ 22°C in fresh water(SUNTIO 86) 8.57(MACLEAN 88)
6	23.18(MACKAY 75) 27.0(BOBRA 83)
12	14.59(MACKAY 75) 14.6(BOBRA 83)
20.4	7.33(MACKAY 75) 7.3(BOBRA 83)
29	2.27(MACKAY 75)
36	0.68(BOBRA 83)
43.2	0.14(BOBRA 83)

NOTE: FOR (BOBRA 83) SOLUBILITY WAS MEASURED IN DOUBLE
DISTILLED WATER AT ROOM TEMPERATURE.

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

WEATHERING
(WT %)48 hour LC₅₀
(mg/L)

0	9.0 (BOBRA 83) 18.5 (BOBRA 88)
6	10.8 (BOBRA 83)
12	6.0 (BOBRA 83)
20.4	4.4 (BOBRA 83)
36.7	0.49 (BOBRA 83)
43.2	0.12 (BOBRA 83)

48 hour EC₅₀: 3.4 (BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

48 hour EC₅₀: 3.61 (MACLEAN 88)

8.59 (BOBRA 88)

48 hour LC₅₀: 4.34 (MACLEAN 88)

10.3 (BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE
SPECTROSCOPY.RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP
GC ANALYSIS.ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO LARVAL RAINBOW
TROUT:48 hour LC₅₀ (closed container): 10.4 (LOCKHART 87)48 hour LC₅₀ (open container): 11.6 (LOCKHART 87)

16.0 SULPHUR (WT %): 0.37 (EETD 86)

17.0 OTHERS:

17.1 FIRE POINT (°C): <13.5 (TWARDUS 80)

17.2 WAX (WT %):

WEATHERING
(WT %)WAX
(WT %)

0	1.76 (MACKAY 82A)
10	2.29 (MACKAY 82A)
20	1.90 (MACKAY 82A)

1.0 TYPE: NORTH SLOPE CRUDE OIL. ALASKA.

2.0 API GRAVITY: 26.8(API 81)

3.0 DENSITY (g/mL):
@ 15.5 °C: 0.893(API 81)

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT -----	TEMPERATURE (°C) -----
5	98
10	131
15	161
20	193
25	216
30	241
35	262
40	282
45	301
50	323
55	342
60	361
65	380
70	400
75	419
80	439
85	461
90	484
95	511
FBP	539

NOTE: DATA FROM SIMULATED DISTILLATION ASTM METHOD D 2887
(API 81)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 1.04(API 81)

17.0 OTHERS:

17.1 NITROGEN (WT %): 0.20(API 81)

17.2 METALS (PPM): NICKEL: 21(API 81)
VANADIUM: 9.4 TO 9.7(API 81)

1.0 TYPE: PANUKE F-99 CRUDE OIL, CANADIAN EASTCOAST OFFSHORE.
DATA FOR SEPARATOR OIL SAMPLED 87/08/07, PETRO-CANADA
INCORPORATED.

2.0 API GRAVITY (15.5/15.5°C): 56.9 (PETRO-CAN 87)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
0	
15	0.7507 (PETRO-CAN 87)

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 RELATIVE MOLECULAR MASS: 122.94 (PETRO-CAN 87)

17.2 COMPOSITIONAL ANALYSIS:

COMPONENT	MOLE FRACTION	MASS FRACTION	VOLUME FRACTION
N ₂	0.0001	0.0000	0.0000
CO ₂	0.0013	0.0005	0.0004
H ₂ S	0.0000	0.0000	0.0000
C ₁	0.0131	0.0017	0.0043
C ₂	0.0024	0.0006	0.0012
C ₃	0.0153	0.0055	0.0081
iC ₄	0.0255	0.0121	0.0161
C ₄	0.0420	0.0198	0.0255
iC ₅	0.0518	0.0304	0.0365
C ₅	0.0552	0.0324	0.0385
C ₆	0.0931	0.0655	
C ₇	0.0918	0.0751	
C ₈	0.0959	0.0893	
C ₉	0.0559	0.0585	
C ₁₀	0.0615	0.0714	
C ₁₁	0.0432	0.0551	
C ₁₂	0.0358	0.0498	
C ₁₃	0.0298	0.0449	
C ₁₄	0.0267	0.0432	
C ₁₅	0.0240	0.0416	
C ₁₆	0.0190	0.0351	
C ₁₇	0.0140	0.0274	
C ₁₈	0.0126	0.0262	
C ₁₉	0.0105	0.0230	
C ₂₀	0.0075	0.0173	
C ₂₁	0.0054	0.0131	
C ₂₂	0.0046	0.0117	
C ₂₃	0.0029	0.0076	
C ₂₄	0.0022	0.0061	
C ₂₅	0.0018	0.0052	
C ₂₆	0.0012	0.0035	
C ₂₇	0.0008	0.0025	
C ₂₈	0.0005	0.0018	
C ₂₉	0.0005	0.0016	
C ₃₀₊	0.0006	0.0030	
AROMATICS:			
C ₆ H ₁₀	0.0003	0.0002	
C ₇ H ₈	0.0020	0.0015	
C ₈ H ₁₀	0.0157	0.0136	
C ₈ H ₁₀	0.0087	0.0076	
C ₉ H ₁₂	0.0070	0.0069	
NAPHTHALENES:			
C ₅ H ₁₀	0.0042	0.0024	
C ₆ H ₁₂	0.0186	0.0128	
C ₆ H ₁₂	0.0311	0.0213	
C ₇ H ₁₄	0.0639	0.0512	(PETRO-CAN 87)

1.0 TYPE: PIPER CRUDE OIL, NORTH SEA.

2.0 API GRAVITY: 35.2(HMSO 76)

3.0 DENSITY (g/mL):
@ 15 °C: 0.849(HMSO 76)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 50 °C: 3.55(HMSO 76)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -9 (-3)(HMSO 76)

NOTE: FIGURES IN BRACKETS ARE OBTAINED FROM
THE OIL INDUSTRY AND ARE THOSE WHICH
DO NOT AGREE WITH THE PUBLISHED DATA
(HMSO 76)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

WEIGHT PERCENT	TEMPERATURE (°C)
-----	-----
8.4, (8.3)	5 TO 100(HMSO 76)
17.6, (12.1)	100 TO 160(HMSO 76)
11.9, (12.9)	160 TO 250(HMSO 76)
17.9, (18.7)	250 TO 350(HMSO 76)
44.2, (48)	>350(HMSO 76)

NOTE: FIGURES IN BRACKETS ARE OBTAINED FROM THE OIL
INDUSTRY AND ARE THOSE WHICH DO NOT AGREE WITH
THE PUBLISHED DATA.(HMSO 76)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.92 (HMSO 76)

17.0 OTHERS:

17.1 WAX (WT %): 4 (HMSO 76)

1.0 TYPE: SHELL SPECIAL PRIMER ASPHALT.

2.0 API GRAVITY (15/15°C): 18.6(EETD 85)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	0.9526(EETD 85)
---	-----------------

15	0.9421(EETD 85)
----	-----------------

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	12,700(EETD 85)
---	-----------------

15	3,280(EETD 85)
----	----------------

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	28.8(EETD 85)
---	---------------

15	28.3(EETD 85)
----	---------------

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	-------------------

0	26.8(EETD 85)
---	---------------

15	24.7(EETD 85)
----	---------------

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
--------------	--------------------

0	28.9 (EETD 85)
---	----------------

15	27.8 (EETD 85)
----	----------------

6.0 POUR POINT (°C): -17 (EETD 85)

7.0 FLASH POINT (°C): 16 (C.C.) (EETD 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
--------------	--------------------

0	0 (EETD 85)
---	-------------

15	1.0 (EETD 85)
----	---------------

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
--------------	--------------------

0	0 (EETD 85)
---	-------------

15	1.0 (EETD 85)
----	---------------

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
--------------	--------------------

0	N/A (EETD 85)
---	---------------

15	55.1 (EETD 85)
----	----------------

11.0 WEATHERING:

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (%)	
0	7 (EETD 85)	
15	37 (EETD 85)	

12.2 NATURAL DISPERSIBILITY:

TEMP (°C)	WEATHERING (%)	
0	0 (EETD 85)	
15	0 (EETD 85)	

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: PRUDHOE BAY CRUDE OIL, NORTH SLOPE, ALASKA.

2.0 API GRAVITY: 27.0(USCG 72)
27.0(COLEMAN 78)

3.0 DENSITY (g/mL):

For Fw < 24.1 % and T between 0 and 25 °C:

DEN = 0.913841 + 0.001582 Fw - 0.000955 T

where: DEN is density of oil at T and Fw (g/mL)

Fw is weight percent of oil weathered

T is oil temperature (°C)

TEMP (°C)	WEATHERING (WT %)				
	0	7.3	9.8	11.2	24.1
0	0.915 (MACKAY 82A) 0.909 (MACKAY 82B)				
5	0.911 (MACKAY 82A) 0.906 (MACKAY 75)		0.925 (MACKAY 75)		0.950 (MACKAY 75)
10	0.910 (MACKAY 82A)				
15	0.905 (MACKAY 82A) 0.899 (MACKAY 75)		0.916 (MACKAY 75)		0.937 (MACKAY 75)
15.6	0.893 (COLEMAN 78)				
20	0.902 (MACKAY 82A) 0.901 (MACKAY 82A) 0.884 (MACKAY 80A) 0.881 (USCG 71)	0.902 (MACKAY 82A)		0.910 (MACKAY 80A)	
25	0.900 (MACKAY 82A) 0.888 (MACKAY 75)		0.905 (MACKAY 75)		0.928 (MACKAY 75)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (WT %)				
	0	7.3	9.8	11.2	24.1
-20	180 (MACKAY 75)		540 (MACKAY 75)		3700 (MACKAY 75)
-15	135 (MACKAY 75)		420 (MACKAY 75)		4000 (MACKAY 75)
- 8	1000 (MARTIN 77)				
- 2	170 (MARTIN 77)				
0	68 (MACKAY 75) 500 (MACKAY 82B) 50 (MACKAY 80A) 19 (MARTIN 77) 577 (MACKAY 82A)	108 (MACKAY 80A)	205 (MACKAY 75)	204 (MACKAY 80A)	1700 (MACKAY 75)
5	196 (MACKAY 82A) 140 (USCG 71)				
10	103 (MACKAY 82A) 80 (USCG 71) 96 (MACKAY 82B)				
15	33 (MACKAY 75) 26 (MACKAY 80A) 68.4 (MACKAY 75) 50 (USCG 71)	62 (MACKAY 80A)	102 (MACKAY 75)	105 (MACKAY 80A)	820 (MACKAY 75)

4.1 DYNAMIC VISCOSITY (mPa.s or cp) (continued):

TEMP (°C)	WEATHERING (WT %)				
	0	7.3	9.8	11.2	24.1
20	45.7 (MACKAY 82A) 34.9 (MACKAY 82B)				
25	20 (MACKAY 75) 17 (MACKAY 80A) 35.3 (MACKAY 82A)	37 (MACKAY 80A)	55 (MACKAY 75)	61 (MACKAY 80A)	400 (MACKAY 75)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (WT %)		
	0	9.8	24.1
0	630 (MACKAY 82A)		
5	216 (MACKAY 82A)		
10	113 (MACKAY 82A)		
15	37 (MACKAY 75) 75.5 (MACKAY 82A)	111 (MACKAY 75)	878 (MACKAY 75)
20	50.7 (MACKAY 82A)		
25	23 (MACKAY 75) 39.2 (MACKAY 82A)	61 (MACKAY 75)	431 (MACKAY 75)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	30.4 (EETD 85)
15	28.3 (EETD 85)
20	30.1 (MACKAY 82B)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	15.0 (EETD 85)
15	9.7 (EETD 85)
20	27.0 (MACKAY 82B)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	
0	17.6 (EETD 85)
15	16.9 (EETD 85)

6.0 POUR POINT ($^{\circ}\text{C}$):WEATHERING
(WT %)POUR POINT
($^{\circ}\text{C}$)

0	0 (MACKAY 82A) -27 (MACKAY 80) -9.5 (MARTIN 77) -42 (MACKAY 75) -9.1 (USCG 72) -2 (MACKAY 82B) -9.4 (COLEMAN 78)
7.3	-16 (MACKAY 80)
9.8	-27 (MACKAY 75)
11.2	-3 (MACKAY 80)
18.2	-18 (MACKAY 75)
24.1	-11 (MACKAY 75)

7.0 FLASH POINT ($^{\circ}\text{C}$):WEATHERING
(WT %)FLASH POINT
($^{\circ}\text{C}$)

0	30 (O.C.) (MACKAY 80)
7.3	71 (O.C.) (MACKAY 80)
11.2	84 (O.C.) (MACKAY 80)

NOTE: FLASH POINT = $70.0 (1 + 3.7 F)$

WHERE: F = VOL FRACTION EVAPORATED (MACKAY 82B)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	VAPOUR TEMPERATURE	LIQUID TEMPERATURE
-----	-----	-----
IBP	50 (MACKAY 75)	166 (MACKAY 82B)
	67 (MACKAY 80)	
	27 (COLEMAN 78)	
2.1	75 (COLEMAN 78)	
4.7	100 (COLEMAN 78)	
5.0		206 (MACKAY 82B)
8.2	125 (COLEMAN 78)	
10	168 (MACKAY 75)	246 (MACKAY 82B)
11.8	150 (COLEMAN 78)	
15.0		286 (MACKAY 82B)
15.5	175 (COLEMAN 78)	
19.0	200 (COLEMAN 78)	
20	235 (MACKAY 75)	327 (MACKAY 82B)
23.3	225 (COLEMAN 78)	
28.1	250 (COLEMAN 78)	
30	290 (MACKAY 75)	
33.1	275 (COLEMAN 78)	
40	328 (MACKAY 75)	

DATA FROM (MACKAY 75) & (MACKAY 82B) OBTAINED FROM CURVE

10.0 EMULSION FORMATION TENDENCY & STABILITY:

FORMS FAIRLY STABLE EMULSION (MACKAY 82B)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 8,281.2 \theta \exp(6.3 - 4,521.7/T_k)/T_k)}{(8,281.2/T_k)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporative exposure
 $\exp$ is exponential base e
 T_k is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (MACKAY 82B)

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	61.2 (CLARK 77)
	86.9 (MACKAY 82A)
	78.3 (EETD 86)
AROMATICS	35.6 (CLARK 77)
	9.94 (MACKAY 82A)
	17.6 (EETD 86)
POLARS	2.9 (CLARK 77)
	1.6 (MACKAY 82A)
	2.5 (EETD 86)
ASPHALTENES	1.2 (CLARK 77)
	1.53 (MACKAY 82A)
	2.4 (MACKAY 82B)
	1.6 (EETD 86)

14.0 AQUEOUS SOLUBILITY (mg/L):

WEATHERING (WT %)	AQUEOUS SOLUBILITY (mg/L)
0	41.7 (MACKAY 80) 29.25 (MACKAY 75) 29.3 (BOBRA 83) 29.2 @ 20°C (MACKAY 82B) 25.5 @ 22°C in fresh water (SUNTIO 86) 20.5 @ 22°C in salt water (SUNTIO 86) 23.90 (RICE 76)
7.3	15.0 (MACKAY 80)
9.8	4.89 (MACKAY 75) 4.91 (BOBRA 83)
11.2	7.6 (MACKAY 80)
18.2	0.153 (BOBRA 83)
24.4	0.102 (BOBRA 83)

NOTES: SOLUBILITY = 29.2 EXP(-12.0 Fv)

WHERE: Fv = VOL FRACTION EVAPORATED (MACKAY 82B)

NOTE: (BOBRA 83) SOLUBILITY MEASURED IN DOUBLE DISTILLED WATER
AT ROOM TEMPERATURE.

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

WEATHERING

48 hour LC₅₀

(WT %)

(mg/L)

0	9.4 (BOBRA 83)
9.8	3.9 (BOBRA 83)
18.2	0.15 (BOBRA 83)
24.4	0.10 (BOBRA 83)

96 HOUR LC₅₀ VALUES (freshwater) OF WATER SOLUBLE FRACTION:

ARCTIC CHAR: 2.17 (MOLES 79)

ARCTIC GRAYLING: 2.04 (MOLES 79)

CHINOOK SALMON: 1.47 (MOLES 79)

COHO SALMON: 1.45 (MOLES 79)

DOLLY VARDEN: 1.25 (MOLES 79)

SLIMY SCULPIN: 3.00 (MOLES 79)

SOCKEYE SALMON: 1.79 (MOLES 79)

3-SPINE STICKLEBACK: 6.89 (MOLES 79)

16.0 SULPHUR (WT %): 0.82 (USCG 72)
0.82 (COLEMAN 78)

17.0 OTHERS:

17.1 COLOUR: BROWNISH BLACK(USCG 72)

17.2 FIRE POINT ($^{\circ}\text{C}$):

WEATHERING (WT %)	FIRE POINT ($^{\circ}\text{C}$)
0	35(MACKAY 80)
7.3	86(MACKAY 80)
11.2	91(MACKAY 80)

17.3 INITIAL BOILING POINT ($^{\circ}\text{C}$):

WEATHERING (WT %)	IBP ($^{\circ}\text{C}$)
0	67(MACKAY 80)
7.3	102(MACKAY 80)
11.2	192(MACKAY 80)

17.4 WAX (WT %): 3.86(MACKAY 82A)
4.5(MACKAY 82B)

$$\text{WAX} = 0.045 / (1 - F)$$

WHERE: WAX = WAX CONTENT (MASS FRACTION)

F = VOL FRACTION EVAPORATED(MACKAY 82B)

17.5 CARBON RESIDUE (WT %): 4.7(USCG 72)

17.6 NITROGEN (WT %): 0.230(COLEMAN 78)

1.0 TYPE: RAINBOW LIGHT & MEDIUM CRUDE OIL, ALBERTA.

2.0 API GRAVITY: 40.7(AALUND 83A)

3.0 DENSITY (g/mL):

 @ 21 °C: 0.8210(AALUND 83A)

4.0 VISCOSITY:

 4.1 DYNAMIC VISCOSITY:

 4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

 @ 40 °C: 3.77(AALUND 83A)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): 2.5(AALUND 83A)

7.0 FLASH POINT:

8.0 REID VAPOUR PRESSURE (kPa): 33.9(AALUND 83A)

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (PPM): 5,000(AALUND 83A)

17.0 OTHERS:

 17.1 CON. CARBON (WT %): 1.65(AALUND 83A)

 17.2 METALS (PPM): NICKEL: 0.85(AALUND 83A)
 VANADIUM: 0.50(AALUND 83A)

 17.3 H₂S (PPM): 10.2(AALUND 83A)

 17.4 WAX (WT %): 20.40(AALUND 83A)

17.5 YIELD ON CRUDE:

	----- RANGE, °C -----	----- VOL % -----
NAPHTHA	C ₅ - 190	38.70
KEROSINE	190 - 277	13.00
DISTILLATE	277 - 343	11.50
GAS OIL	343 - 565	31.65
RESIDUE	565 +	5.15

(AALUND 83A)

- 1.0 TYPE: RANGELAND-SOUTH L & M CRUDE OIL.
- 2.0 API GRAVITY: 39.5(AALUND 83A)
- 3.0 DENSITY (g/mL):
 - @ 21 °C: 0.8267(AALUND 83A)
- 4.0 VISCOSITY:
 - 4.1 DYNAMIC VISCOSITY:
 - 4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
 - @ 40 °C: 2.67(AALUND 83A)
- 5.0 INTERFACIAL TENSIONS:
- 6.0 POUR POINT (°C): -40(AALUND 83A)
- 7.0 FLASH POINT:
- 8.0 REID VAPOUR PRESSURE (kPa): 39.3(AALUND 83A)
- 9.0 DISTILLATION DATA:
- 10.0 EMULSION FORMATION TENDENCY & STABILITY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:
- 13.0 HYDROCARBON GROUP ANALYSIS:
- 14.0 AQUEOUS SOLUBILITY:
- 15.0 TOXICITY:
- 16.0 SULPHUR (PPM): 7,520(AALUND 83A)
- 17.0 OTHERS:
 - 17.1 CON. CARBON (WT %): 0.69(AALUND 83A)
 - 17.2 METALS (PPM): NICKEL: 1.20(AALUND 83A)
VANADIUM: 1.40(AALUND 83A)
 - 17.3 H₂S (PPM): 20.1(AALUND 83A)
 - 17.4 WAX (WT %): 12.44(AALUND 83A)

17.5 YIELD ON CRUDE:

	RANGE, °C	VOL %
NAPHTHA	C ₅ - 190	38.75
KEROSINE	190 - 277	15.50
DISTILLATE	277 - 343	8.55
GAS OIL	343 - 565	33.20
RESIDUE	565 +	4.0

(AALUND 83A)

1.0 TYPE: SABLE ISLAND LIQUID CONDENSATE.

2.0 API GRAVITY: 39.9 (ROSS 82A)

3.0 DENSITY (g/mL):

For $F < 82$ % & T between 0 and 25 °C:

$DEN = 0.865048 + 0.000383 F - 0.000298 T$

where: DEN is density of oil at T and F (g/mL)

F is percent of oil weathered

T is oil temperature (°C)

TEMP (°C)	WEATHERING (%)			
	0	41	71	82
0	0.878 (MACKAY 82A)			
5	0.834 (ROSS 82A) 0.876 (MACKAY 82A)	0.875 (ROSS 82A)	0.885 (ROSS 82A)	0.914 (ROSS 82A)
10	0.875 (MACKAY 82A)			
15	0.823 (ROSS 82A) 0.874 (MACKAY 82A)	0.869 (ROSS 82A)	0.870 (ROSS 82A)	0.899 (ROSS 82A)
20	0.872 (MACKAY 82A)			
25	0.869 (MACKAY 82A)			

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING			
	(%)			
	0	41	71	82
0	12.8 (MACKAY 82A)			
5	2.7 (ROSS 82A) 4.96 (MACKAY 82A)	88.0 (ROSS 82A)	2250 (ROSS 82A)	6600 (ROSS 82A)
10	3.39 (MACKAY 82A)			
15	2.02 (ROSS 82A) 2.96 (MACKAY 82A)	5.55 (ROSS 82A)	320 (ROSS 82A)	2450 (ROSS 82A)
20	2.67 (MACKAY 82A)			
25	2.41 (MACKAY 82A)			

4.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):
WEATHERING

TEMP (°C)	0	41 (%)	71	82
0	14.6 (MACKAY 82A)			
5	3.2 (ROSS 82A) 5.66 (MACKAY 82A)	100.6 (ROSS 82A)	2542 (ROSS 82A)	7221 (ROSS 82A)
10	3.87 (MACKAY 82A)			
15	2.45 (ROSS 82A) 3.39 (MACKAY 82A)	6.39 (ROSS 82A)	368 (ROSS 82A)	2725 (ROSS 82A)
20	3.06 (MACKAY 82A)			
25	2.77 (MACKAY 82A)			

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm): 28.5 (ROSS 82A)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

29.6 (ROSS 82A)

18.4 (MACKAY 82A)

6.0 POUR POINT:

WEATHERING
(%)POUR POINT
(°C)

0	-22 (ROSS 82A) 3 (MACKAY 82A) -51 (EETD 86)
41	3 (ROSS 82A)
71	18 (ROSS 82A)
82	27 (ROSS 82A)

7.0 FLASH POINT:

WEATHERING
(%)FLASH POINT
(°C)

0	16(O.C.) (ROSS 82A) -11(C.C.) (EETD 86)
41	81(O.C.) (ROSS 82A)
71	135(O.C.) (ROSS 82A)
82	147(O.C.) (ROSS 82A)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME
FRACTIONTEMPERATURE
(°C)

0.15	103
0.30	123
0.50	156
0.70	220(ROSS 82A)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

WEATHERING
(%)TEMP
(°C)

0	0(EETD 86)
15	0(EETD 86)

10.2 EMULSION STABILITY:

WEATHERING
(%)TEMP
(°C)

0	0(EETD 86)
15	0(EETD 86)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

WEATHERING	
TEMP (°C)	(%)
0	0
0	N/A (EETD 86)
15	N/A (EETD 86)

11.0 WEATHERING:

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO: 20 TO 1.

WEATHERING	
TEMP (°C)	(%)
0	0
0	93.1 (EETD 86)
15	93.4 (EETD 86)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

WEATHERING	
TEMP (°C)	(%)
0	0
0	4.8 (EETD 86)
15	27.8 (EETD 86)

NOTE: LITTLE TENDENCY TO DISPERSE AT 5°C FOR FRESH AND
42% WEATHERED OIL (ROSS 82A)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	88.4 (MACKAY 82A)
	81.04 (ROSS 82A)
AROMATICS	10.8 (MACKAY 82A)
POLARS	0.23 (MACKAY 82A)
ASPHALTENES	0.60 (MACKAY 82A)

14.0 AQUEOUS SOLUBILITY (mg/L):

IN	WEATHERING	
	(%)	
	0	42
SALT WATER	58.08 (ROSS 82A) 11.93 (MACLEAN 88)	5.34 (ROSS 82A)
FRESH WATER @ 22°C	76.0 (SUNTIO 86) 14.4 (MACLEAN 88)	
DISTILLED WATER	74.65 (ROSS 82A)	8.02 (ROSS 82A)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

Sable Island Condensate:

48 hour EC50: 0.41 (MACLEAN 88)

2.1 (BOBRA 88)

48 hour LC50: 3.41 (MACLEAN 88)

18 (BOBRA 88)

Venture Condensate:

48 hour EC50: 0.83 (MACLEAN 88)

48 hour LC50: 5.84 (MACLEAN 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

Sable Island Condensate:

48 hour EC50: 1.94 (MACLEAN 88)

9.84 (BOBRA 88)

48 hour LC50: 2.58 (MACLEAN 88)

13.13 (BOBRA 88)

Venture Condensate:

48 hour EC50: 3.72 (MACLEAN 88)

48 hour LC50: 4.33 (MACLEAN 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE SPECTROSCOPY.

RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP GC ANALYSIS.

NOTE: Toxicity tests by Hutcheson used Venture Field Condensate from intervals 4678 TO 4691 m.

RAINBOW TROUT (15 °C, FRESHWATER):

24 hour LC50: 6.0 uL/L

96 hour LC50: 5.6 uL/L

LTC: 5 uL/L

INCIPIENT LETHAL THRESHOLD CONC: 5 uL/L

ET50 (SWIMMING): < 1 H

EC50 (SWIMMING): <4.9 uL/L

(HUTCHESON 83)

15.0 TOXICITY (continued):

GREEN SEA URCHIN (10 °C, SEAWATER):

LTC: ABOUT 40.5 uL/L

INCAPACITATED ABOUT 3.8 uL/L

NO ACUTE OR DELAY MORTALITIES UP TO 33.5 uL/L
AFTER 96HDELAY MORTALITIES > OR = 33.5 uL/L
(HUTCHESON 83)

16.0 SULPHUR (WT %): 0.03 (EETD 86)

17.0 OTHERS:

17.1 COLOUR: CLEAR, PALE YELLOW (HUTCHESON 83)

17.2 FIRE POINT:

WEATHERING
(%)FIRE POINT
(°C)

0	16 (ROSS 82A)
41	84 (ROSS 82A)
71	141 (ROSS 82A)
82	161 (ROSS 82A)

17.3 WAX (WT %): 2.01 (MACKAY 82A)

17.4 H₂S (PPM): 0 (ROSS 82A)

1.0 TYPE: SOUR BLEND CRUDE OIL.

2.0 API GRAVITY (15/15 °C): 34.8(EETD 84)

3.0 DENSITY (g/mL):

For T between 0 and 25 °C:

DEN = 0.856 - 0.00077 T

where: DEN is density of fresh oil at T (g/mL)

T is oil temperature (°C)

TEMP (°C)	WEATHERING (WT %)		
	0	10	20
0	0.861(EETD 84) 0.852(MACKAY 82A)		
5	0.850(MACKAY 82A)		
10	0.847(MACKAY 82A)		
15	0.850(EETD 84) 0.842(MACKAY 82A)		
20	0.840 (MACKAY 82A)	0.861 (MACKAY 82A)	0.875 (MACKAY 82A)
25	0.836(MACKAY 82A)		

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

$$\text{VISC} = \exp(3.189 - 4691.9 T / (273(T+273)))$$

where: VISC is dynamic viscosity of fresh oil at T
(mPa.s)

exp is exponential base e

T is oil temperature (°C)

TEMP (°C)	WEATHERING (%)	
	0	
0	24.2 (MACKAY 82A)	26.7 (TWARDUS 80)
5	16.9 (MACKAY 82A)	
10	10.9 (MACKAY 82A)	19.4 (TWARDUS 80)
15	8.20 (MACKAY 82A)	
20	6.59 (MACKAY 82A)	9.5 (TWARDUS 80)
25	5.95 (MACKAY 82A)	

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (%)	
	0	
0	28.4 (MACKAY 82A)	
5	19.9 (MACKAY 82A)	
10	12.9 (MACKAY 82A)	
15	9.74 (MACKAY 82A)	
20	7.85 (MACKAY 82A)	
25	7.12 (MACKAY 82A)	

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

15	25.8 (EETD 84) 25.6 (EETD 85)
----	----------------------------------

ROOM	24.1 (TWARDUS 80)
------	-------------------

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

15	0.75 (EETD 84)
----	----------------

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)
0	

15	13.0 (EETD 85)
----	----------------

ROOM	27.5 (TWARDUS 80)
------	-------------------

6.0 POUR POINT (°C):

WEATHERING (WT %)
0

POUR POINT (°C)
6 (MACKAY 82A) -50 (TWARDUS 80)

10
20

6 (MACKAY 82A)
9 (MACKAY 82A)

7.0 FLASH POINT (°C): 6.6 (C.C.) (EETD 84)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	VAPOUR TEMPERATURE	LIQUID TEMPERATURE
IBP	45	114
5		140
10	95	164
15		188
20	130	213
25		239
30	180	264 (EETD 84)
40	235	
50	300	
60	345	
70	380	
80	385	
85	390 (TWARDUS 80)	

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (%)
0	0
0	0.58 (EETD 84)
15	0 (EETD 84)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (%)
0	0
0	0.9 (EETD 84)
15	0.1 (EETD 84)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (%)
0	0
0	92.3 (EETD 84)
15	N/A (EETD 84)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 5217 \theta \exp(6.3 - 3975.8/TK)/TK)}{(5217/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (EETD 84)

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

GROUP	WEATHERING (WT %)		
	0	10	20
SATURATES	82.3	76.9	72.5
AROMATICS	13.2	14.7	16.4
POLARS	2.33	3.86	4.34
ASPHALTENES	2.21	4.58	6.73

(MACKAY 82A)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 FIRE POINT ($^\circ C$): <10.5 (TWARDUS 80)

17.2 IN-SITU COMBUSTION OF FRESH OIL:

EASILY IGNITED, 5.0 WT % RESIDUE (TWARDUS 80)

17.3 WAX (WT %):

WEATHERING (WT %)	WAX (WT %)
0	5.62 (MACKAY 82A)
10	8.49 (MACKAY 82A)
20	9.95 (MACKAY 82A)

1.0 TYPE: SOUTH LOUISIANA CRUDE OIL.

2.0 API GRAVITY: 37.0(API 81)
34.5(PANCIROV 74)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.839(API 81)

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT -----	TEMPERATURE (°C) -----
5	76
10	105
15	132
20	156
25	178
30	203
35	221
40	239
45	254
50	271
55	284
60	302
65	321
70	341
75	362
80	384
85	411
90	440
95	468
FBP	530(API 81)

NOTE: (API 81) DATA FROM SIMULATED DISTILLATION ASTM
METHOD D 2887

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	65.1
AROMATICS	26.3
POLARS	8.4
ASPHALTENES	0.2 (CLARK 77)

14.0 AQUEOUS SOLUBILITY (mg/L):

in seawater:	23.37 (ANDERSON 74)
in distilled water:	37.9 (MURRAY 84)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION:

SPECIES	24 hour LC50	48 hour LC50	96 hour LC50
POLYCHAETA:			
PLATYNEREIS DUMERILII		12.3 (NEFF 76)	9.5 (NEFF 76)
NEANTHES ARENACEODENTATA	18.0 (ROSSI 76)	13.9 (ROSSI 76)	12.5 (ROSSI 76)
CAPITELLA CAPITATA	>19.8 (ROSSI 76)	16.2 (ROSSI 76)	12.0 (ROSSI 76)
CRUSTACEA:			
MYSIDOPSIS ALMYRA	11.7 (ANDERSON 74)	8.7 (ANDERSON 74)	
LEANDER TENUICORNIS		10.2 (NEFF 76)	6.0 (NEFF 76)
PALAEONETES PUGIO	>16.8 (ANDERSON 74)	>16.8 (NEFF 76)	>16.8 (NEFF 76)
PENAEUS AZTECUS	>19.8 (ANDERSON 74)	>19.8 (NEFF 76)	>19.8 (NEFF 76)
FISH:			
MENIDIA BERYLLINA	9.7 (ANDERSON 74)	8.7 (NEFF 76)	5.5 (NEFF 76)
FUNDULUS SIMILIS	16.8 (ANDERSON 74)	16.8 (NEFF 76)	16.8 (NEFF 76)
CYPRINODON VARIEGATUS	>19.8 (ANDERSON 74)	>19.8 (NEFF 76)	>19.8 (NEFF 76)

ACUTE TOXICITY OF OIL-IN-WATER DISPERSION:

SPECIES	24 hour LC50	48 hour LC50	96 hour LC50
CRUSTACEA:			
MYSIDOPSIS ALMYRA	165	37.5	
PALAEONETES FUGIO	1,700	1,650	200
PENAEUS AZTECUS	>1,000	>1,000	>1,000
FISH:			
MENIDIA BERYLLINA	7,600	5,000	3,700
FUNDULUS SIMILIS	6,610	6,000	6,000
CYPRINODON VARIEGATUS	80,000	33,000	29,000

(ANDERSON 74)

16.0 SULPHUR (WT %): 0.21(API 81)
0.25(PANCIROV 74)

17.0 OTHERS:

17.1 NITROGEN (WT %): 0.031(API 81)
0.69(PANCIROV 74)

17.2 METALS (PPM): NICKEL: 1.1(API 81)
2.2(PANCIROV 74)
VANADIUM: 0.9(API 81)
1.9(PANCIROV 74)

1.0 TYPE: STATFJORD CRUDE OIL. NORWAY & U.K., NORTH SEA.

2.0 API GRAVITY: 38.4(AALUND 83B)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (VOL %)			
	0	20.1	32.3	42.1
15.5	0.834 (DALING 87)	0.867 (DALING 87)	0.882 (DALING 87)	0.895 (DALING 87)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)			
	0	20.1	32.3	42.1
6	12 (DALING 87)	50 (DALING 87)	113 (DALING 87)	483 (DALING 87)
13	7 (DALING 87)	20 (DALING 87)	57 (DALING 87)	221 (DALING 87)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 15°C: 7.33(AALUND 83B)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL:

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)			
	0	20.1	32.3	42.1
13	23 (DALING 87)	16 (DALING 87)	15 (DALING 87)	16 (DALING 87)

6.0 POUR POINT (°C):

WEATHERING
(VOL %)POUR POINT
(°C)

0	-15 (DALING 87) 4 (AALUND 83B)
20.1	7 (DALING 87)
32.3	11 (DALING 87)
42.1	16 (DALING 87)

7.0 FLASH POINT:

8.0 REID VAPOUR PRESSURE (kPa): 37.9 (AALUND 83B)

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

For oil weathered 42.1 % by volume:

SATURATES	56.2
AROMATICS	34.8
POLARS	7.8
ASPHALTENES	1.2 (DALING 87)

WEATHERING
(VOL %)ASPHALTENES
"hard" "soft"

0	0.01 (DALING 87)	0.39 (DALING 87)
20.1	0.01 (DALING 87)	0.47 (DALING 87)
32.3	0.02 (DALING 87)	0.54 (DALING 87)
42.1	0.02 (DALING 87)	0.63 (DALING 87)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.27 (AALUND 83B)

17.0 OTHERS:

17.1 WAX (WT %):

WEATHERING
(VOL %)WAX CONTENT
(WT %)

0	4.14 (DALING 87)
20.1	4.78 (DALING 87)
32.3	5.77 (DALING 87)
42.1	6.68 (DALING 87)

17.2 TOTAL NITROGEN (PPM): 1.03 (AALUND 83B)

17.3 METALS (PPM): VANADIUM: 0.53 (AALUND 83B)
NICKEL: 1.03 (AALUND 83B)

17.4 CARBON RESIDUE (WT %): 1.32 (AALUND 83B)

17.5 YIELD ON CRUDE:

	RANGE, °C	VOL %
C ₅ & lighter		5.08
NAPHTHA	15 - 38	6.49
NAPHTHA	38 - 182	22.12
KEROSINE	182 - 262	15.08
LIGHT GAS OIL	262 - 377	22.22
HEAVY GAS OIL	377 - 508	22.09
RESIDUE	508 +	9.84

(AALUND 83B)

1.0 TYPE: SWANSON RIVER CRUDE OIL, COOK INLET, ALASKA.

2.0 API GRAVITY: 29.7(COLEMAN 78)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.878(COLEMAN 78)

4.0 VISCOSITY (Saybolt Universal seconds):
@ 25 °C: 105(COLEMAN 78)
@ 37.8 °C: 61(COLEMAN 78)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): <-15(COLEMAN 78)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

CUT TEMPERATURE (°C)	VOLUME PERCENT
-----	-----
26	IBP
50	1.9
75	4.8
100	7.7
125	12.9
150	18.9
175	23.4
200	27.4
225	31.7
250	36.5
275	43.2
-----	-----

(COLEMAN 78)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.16(COLEMAN 78)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 8.1(COLEMAN 78)

17.2 NITROGEN (WT %): 0.203(COLEMAN 78)

17.3 COLOUR: BROWNISH BLACK(COLEMAN 78)

1.0 TYPE: SWEET BLEND CRUDE OIL.

2.0 API GRAVITY (15/15°C): 38.6(MACKAY 82A)

3.0 DENSITY (g/mL):

$$\text{DEN} = 0.8406 - 0.0006 T$$

where: DEN is density of fresh oil at T (g/mL)

T is oil temperature (°C)

TEMP (°C)	WEATHERING (WT %)		
	0	10	20
0	0.840(MACKAY 82A)		
5	0.838(MACKAY 82A)		
10	0.835(MACKAY 82A)		
15	0.831(MACKAY 82A)		
20	0.829 (MACKAY 82A)	0.847 (MACKAY 82A)	0.859 (MACKAY 82A)
25	0.825(MACKAY 82A)		

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

$$\text{VISC} = \exp(2.89 - 4886.5 T / (273(T+273)))$$

where: VISC is dynamic viscosity of fresh oil at T

exp is exponential base e

T is oil temperature (°C)

4.1 DYNAMIC VISCOSITY (mPa.s or cp):
WEATHERING

TEMP (°C)	(%)
0	0
0	21.0 (MACKAY 82A) 20.1 (TWARDUS 80)
5	11.5 (MACKAY 82A)
10	7.99 (MACKAY 82A) 14.2 (TWARDUS 80)
15	5.31 (MACKAY 82A)
20	4.77 (MACKAY 82A) 8.1 (TWARDUS 80)
25	4.13 (MACKAY 82A)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
WEATHERING

TEMP (°C)	(%)
0	0
0	25 (MACKAY 82A)
5	13.7 (MACKAY 82A)
10	9.6 (MACKAY 82A)
15	6.39 (MACKAY 82A)
20	5.75 (MACKAY 82A)
25	5.01 (MACKAY 82A)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

@ ROOM TEMP: 24 (TWARDUS 80)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (WT %)		
	0	10	20
room	19.5 (MACKAY 82A)	16.9 (MACKAY 82A)	20.2 (MACKAY 82A)

5.3 OIL-WATER (mN/m or dynes/cm):

@ ROOM TEMP: 27.3 (TWARDUS 80)

6.0 POUR POINT (°C):

WEATHERING (WT %)	POUR POINT (°C)
0	-33 (MACKAY 82A) -35 (TWARDUS 80)
10	-27 (MACKAY 82A)
20	6 (MACKAY 82A)

7.0 FLASH POINT (°C): <9 (O.C.) (TWARDUS 80)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMPERATURE (°C)
0	50
10	95
20	130
30	185
40	230
50	280
60	335
70	370
80	380
90	385 (TWARDUS 80)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

GROUP	WEATHERING (WT %)		
	0	10	20
PARAFFINS	70.6	82.5	80.8
AROMATICS	21.0	11.9	12.8
POLARS	4.58	2.37	2.75
ASPHALTENES	3.78	3.20	3.62

(MACKAY 82A)

14.0 AQUEOUS SOLUBILITY (mg/L):
in distilled water: 63.5(MURRAY 84)

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 FIRE POINT (°C): 10(O.C.) (TWARDUS 80)

17.2 IN-SITU COMBUSTION OF FRESH OIL:
EASILY IGNITED, 6.1 WT % RESIDUE(TWARDUS 80)

17.3 WAX (WT %):

WEATHERING (WT %)	WAX (WT %)
0	2.18(MACKAY 82A)
10	3.02(MACKAY 82A)
20	3.41(MACKAY 82A)

1.0 TYPE: SYNTHETIC CRUDE OIL FROM SYNCRUDE, AUGUST 1986.

2.0 API GRAVITY (15/15°C): 32.6(EETD 86)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (VOL %)		
	0	11.0	22.4
0	0.8721(EETD 86)	0.8969(EETD 86)	0.9160(EETD 86)
15	0.8614(EETD 86)	0.8868(EETD 86)	0.9058(EETD 86)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)		
	0	11.0	22.4
0	8.8(EETD 86)	15.7(EETD 86)	41.7(EETD 86)
15	4.6(EETD 86)	8.9(EETD 86)	18.8(EETD 86)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (VOL %)		
	0	11.0	22.4
0	8.0(EETD 86)	19.7(EETD 86)	42.0(EETD 86)
15	5.3(EETD 86)	11.1(EETD 86)	20.3(EETD 86)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	11.0	22.4
0	28.1(EETD 86)	31.0(EETD 86)	31.6(EETD 86)
15	25.7(EETD 86)	28.4(EETD 86)	30.1(EETD 86)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	11.0	22.4
0	29.3(EETD 86)	18.6(EETD 86)	17.8(EETD 86)
15	29.0(EETD 86)	29.6(EETD 86)	15.5(EETD 86)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	11.0	22.4
0	31.3(EETD 86)	20.1(EETD 86)	19.2(EETD 86)
15	30.8(EETD 86)	30.5(EETD 86)	18.2(EETD 86)

6.0 POUR POINT (°C):

WEATHERING (VOL %)	POUR POINT (°C)
0	-72(EETD 86)
11.0	-45(EETD 86)
22.4	-36(EETD 86)

7.0 FLASH POINT (°C): <-21(C.C) (EETD 86)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA ($^{\circ}\text{C}$):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	93.5	24.4
5	180	75.0
10	215	113
15	249	142
20	273	168
25	293	192
30	312	210
35	326	223
40	344	234
45	355	243
50	361	250
55	375	262
60	392	277
65	407	293
70	422	313
	(EETD 86)	(EETD 86)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	11.0	22.4
0	0 (EETD 86)	0 (EETD 86)	0 (EETD 86)
15	0 (EETD 86)	0 (EETD 86)	0 (EETD 86)

10.2 EMULSION STABILITY:

TEMP ($^{\circ}\text{C}$)	WEATHERING (VOL %)		
	0	11.0	22.4
0	0 (EETD 86)	0 (EETD 86)	0 (EETD 86)
15	0 (EETD 86)	0 (EETD 86)	0 (EETD 86)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	11.0	22.4
0	N/A(EETD 86)	N/A(EETD 86)	N/A(EETD 86)
15	N/A(EETD 86)	N/A(EETD 86)	N/A(EETD 86)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 6508 \theta \exp(6.3 - 4312/TK)/TK)}{(6508/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (EETD 86)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	11.0	22.4
0	90.1(EETD 86)	66.6(EETD 86)	81.5(EETD 86)
15	92.3(EETD 86)	91.4(EETD 86)	89.9(EETD 86)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	11.0	22.4
0	11.4(EETD 86)	1.0(EETD 86)	0(EETD 86)
15	4.8(EETD 86)	6.1(EETD 86)	2.5(EETD 86)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES	81.8
AROMATICS	17.0
POLARS	0.9
ASPHALTENES	0.3 (EETD 86)

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22°C:	29.9 (SUNTIO 86)
in distilled water:	43.7 (MURRAY 84)
in fresh water:	2.3 (MACLEAN 88)
in seawater:	5.0 (MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHIA MAGNA:

48 hour EC50:	0.23 (MACLEAN 88)
	3.0 (BOBRA 88)
48 hour LC50:	0.84 (MACLEAN 88)
	11.0 (BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

48 hour EC50:	1.4 (MACLEAN 88)
	6.7 (BOBRA 88)
48 hour LC50:	1.88 (MACLEAN 88)
	9.0 (BOBRA 88)

16.0 SULPHUR:

WEATHERING
(VOL %)SULPHUR
(WT %)

0	0.23 (EETD 86)
11.0	0.15 (EETD 86)
22.4	0.20 (EETD 86)

17.0 OTHERS:

1.0 TYPE: TARSIUT A-25 CRUDE OIL, BEAUFORT SEA.

2.0 API GRAVITY: 30.8(DOME 84)

3.0 DENSITY (g/mL):
@ 21 °C: 0.8711(DOME 84)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):
WEATHERING
(%)

TEMP (°C)	0
20	5.432(DOME 84)
30	4.117(DOME 84)
40	3.155(DOME 84)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -31.9(DOME 84)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: TARSIUT CRUDE OIL.

2.0 API GRAVITY: 23.3 TO 30.2 (GULF 83)
28.0 (DOME 84)

3.0 DENSITY (g/mL):

For Fv < 16.4 % & T between 0 and 15 °C:
 $DEN = 0.888923 + 0.00066 Fv - 0.000324 T$
 where: DEN is density of oil at T and Fv (g/mL)
 Fv is volume percent of oil weathered
 T is oil temperature (°C)

TEMP (°C)	WEATHERING (VOL %)		
	0	12.4	16.4
0	0.884 (EETD 84)	0.8998 (EETD 85)	0.9021 (EETD 85)
15	0.875 (EETD 84) 0.895 (GULF 83)	0.8900 (EETD 85)	0.8922 (EETD 85)
15.6	0.8868 (DOME 84)		

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)		
	0	12.4	16.4
0	12.3 (EETD 84)	27.0 (EETD 85)	28.8 (EETD 85)
15	7.4 (EETD 84)	13.4 (EETD 85)	13.9 (EETD 85)
20	7.148 (DOME 84)		
30	5.386 (DOME 84)		
40	4.141 (DOME 84)		

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (%)	
	0	
0	13.9 (EETD 84)	
15	8.5 (EETD 84)	

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	12.4	16.4
0	28.0 (EETD 84)	30.7 (EETD 85)	30.8 (EETD 85)
15	26.5 (EETD 84)	29.1 (EETD 85)	27.7 (EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	12.4	16.4
0	16.6 (EETD 85)	18.0 (EETD 85)	16.3 (EETD 85)
15	14.1 (EETD 85)	13.9 (EETD 85)	14.3 (EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	12.4	16.4
0	20.0 (EETD 84)	19.1 (EETD 85)	18.5 (EETD 85)
15	18.4 (EETD 85)	17.9 (EETD 85)	17.8 (EETD 85)

6.0 POUR POINT (°C): <-61 (GULF 83)
<-60 (DOME 84)

7.0 FLASH POINT (°C): 65 (C.C.) (EETD 84)

8.0 REID VAPOUR PRESSURE (kPa): 0.8 (EETD 84)

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	VAPOUR TEMPERATURE	LIQUID TEMPERATURE
0	82 TO 138	214
5		227
10	168 TO 198	237
15		248
20		261
25		274
30	227 TO 253	287
35		298
40		305
50	274 TO 306	(EETD 85)
70	334 TO 371	
90	431 TO 457	
FINAL	567 TO 610 (GULF 83)	

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (VOL %)		
0	12.4	16.4	
0	0 (EETD 84)		
15	0 (EETD 84)	0 (EETD 85)	0 (EETD 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (VOL %)		
0	12.4	16.4	
0	0 (EETD 84)		
15	0 (EETD 84)	0 (EETD 85)	0 (EETD 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
0	12.4	16.4	
0	N/A (EETD 84)		
15	N/A (EETD 84)	N/A (EETD 85)	N/A (EETD 85)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 2418 \theta \exp(6.3 - 5016/TK)/TK)}{(2418/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (EETD 85)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
 OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	12.4	16.4
0	76(EETD 85)	57(EETD 85)	62(EETD 85)
15	81(EETD 85)	53(EETD 85)	72(EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	12.4	16.4
0	38(EETD 85)	16(EETD 85)	17(EETD 85)
15	30(EETD 85)	22(EETD 85)	39(EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES 91.9
 AROMATICS 7.4
 POLARS 0.4
 ASPHALTENES 0.3 (EETD 86)

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22°C: 2.0(SUNTIO 86)
 in fresh water: 8.20(MACLEAN 88)
 in seawater: 7.2(MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

48 hour EC50: 3.47(MACLEAN 88)

0.85(BOBRA 88)

48 hour LC50: 6.37(MACLEAN 88)

1.55(BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

24 hour EC50: >7.2(MACLEAN 88)

>1.6(BOBRA 88)

24 hour LC50: >7.2(MACLEAN 88)

>1.6(BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE SPECTROSCOPY.

RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP GC ANALYSIS.

16.0 SULPHUR (WT %): 0.09 TO 0.15(GULF 83)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 36(GULF 83)

17.2 METALS (PPM): NICKEL: 0.5(GULF 83)
VANADIUM: 0.34(GULF 83)
COPPER: 1.57(GULF 83)
IRON: 9.57(GULF 83)

1.0 TYPE: TERRA NOVA K-08 DST#1 CRUDE OIL.

2.0 API GRAVITY:

	WEATHERING (WT %)	
0	5.0	14.9

31.0 (PETRO-CAN 85)	29.5 (PETRO-CAN 85)	29.0 (PETRO-CAN 85)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	14.9
-----	-----	-----	-----
15	0.8704	0.8786	0.8809
	(PETRO-CAN 85)	(PETRO-CAN 85)	(PETRO-CAN 85)
-----	-----	-----	-----

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

WEATHERING			
TEMP (°C)	0	5.0	14.9
25	SOLID (PETRO-CAN 85)	SOLID (PETRO-CAN 85)	SOLID (PETRO-CAN 85)
50	8.7 (PETRO-CAN 85)	11.7 (PETRO-CAN 85)	17.8 (PETRO-CAN 85)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C):

WEATHERING (WT %)	POUR POINT (°C)
-----	-----
0	27 (PETRO-CAN 85)
5.0	30 (PETRO-CAN 85)
14.9	33 (PETRO-CAN 85)
-----	-----

7.0 FLASH POINT (°C):

WEATHERING
(WT %)FLASH POINT
(°C)

0	<21 (PETRO-CAN 85)
5.0	32 (PETRO-CAN 85)
14.9	61 (PETRO-CAN 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	WEATHERING (WT %)		
	0	5.0	14.9
IBP	25	85	111
5	98	136	183
10	136	173	217
20	207	240	276
30	270	300	329
40	330	356	381
50	390	412	431
60	448	465	481
70	519	531	546
% off at 524 °C	70.5	69.1	66.9

(ASTM D2887-MODIFIED) (PETRO-CAN 85)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	14.9
1	0.15 (ROSS 85)	0 (ROSS 85)	0 (ROSS 85)
15	1.0 (ROSS 85)	1.0 (ROSS 85)	0 (ROSS 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	14.9
1	1.0 (ROSS 85)	0 (ROSS 85)	0 (ROSS 85)
15	1.0 (ROSS 85)	1.0 (ROSS 85)	0.93 (ROSS 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	14.9
1	49.3 (ROSS 85)	0 (ROSS 85)	0 (ROSS 85)
15	88.9 (ROSS 85)	84.6 (ROSS 85)	57.6 (ROSS 85)

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY (g/m³):
in 35 ppt seawater @ 22°C

WEATHERING (WT %)	SOLUBILITY (g/m ³)
0	19.0 (ROSS 85)
5.0	13.5 (ROSS 85)
14.9	1.3 (ROSS 85)

15.0 TOXICITY:

16.0 SULPHUR (WT %):

WEATHERING
(WT %)SULPHUR
(WT %)

0	0.70 (PETRO-CAN 85)
5.0	0.74 (PETRO-CAN 85)
14.9	0.80 (PETRO-CAN 85)

17.0 OTHERS:

17.1 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	14.9
1	DNS (ROSS 85)	DNS (ROSS 85)	DNS (ROSS 85)
15	DNS (ROSS 85)	DNS (ROSS 85)	DNS (ROSS 85)

NOTE: DNS=DID NOT SPREAD

1.0 TYPE: TERRA NOVA K-08 DST#2 CRUDE OIL.

2.0 API GRAVITY:

	WEATHERING (WT %)
0	5.0
32.9 (PETRO-CAN 85)	30.3 (PETRO-CAN 85)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (WT %)
0	5.0
15	0.8604 (PETRO-CAN 85)
	0.8742 (PETRO-CAN 85)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (WT %)
0	5.0
25	16.7 (PETRO-CAN 85)
	26.5 (PETRO-CAN 85)
50	5.7 (PETRO-CAN 85)
	7.8 (PETRO-CAN 85)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C):

WEATHERING (WT %)	POUR POINT (°C)
0	12 (PETRO-CAN 85)
5.0	15 (PETRO-CAN 85)

7.0 FLASH POINT (°C):

WEATHERING
(WT %)FLASH POINT
(°C)

0

<21 (PETRO-CAN 85)

5.0

<21 (PETRO-CAN 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	0	WEATHERING (WT %) 5.0
-------------------	---	-----------------------------

IBP	2	44
5	87	107
10	117	140
20	173	198
30	233	253
40	288	310
50	346	366
60	408	425
70	472	486

% off at

524 °C

76.0

75.1

(ASTM D2887-MODIFIED) (PETRO-CAN 85)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	19.5
1	1.0 (ROSS 85)	1.0 (ROSS 85)	1.0 (ROSS 85)
15	1.0 (ROSS 85)	1.0 (ROSS 85)	1.0 (ROSS 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	19.5
1	1.0 (ROSS 85)	1.0 (ROSS 85)	1.0 (ROSS 85)
15	1.0 (ROSS 85)	1.0 (ROSS 85)	1.0 (ROSS 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	19.5
1	90.1 (ROSS 85)	87.6 (ROSS 85)	51.1 (ROSS 85)
15	90.0 (ROSS 85)	89.4 (ROSS 85)	88.8 (ROSS 85)

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY (g/m³):
in 35 ppt seawater @ 22°C

WEATHERING (WT %)	SOLUBILITY (g/m ³)
0	27.0 (ROSS 85)
5.0	19.1 (ROSS 85)
19.5	0.9 (ROSS 85)

15.0 TOXICITY:

16.0 SULPHUR (WT %):

WEATHERING
(WT %)SULPHUR
(WT %)

0

0.69 (PETRO-CAN 85)

5.0

0.71 (PETRO-CAN 85)

17.0 OTHERS:

17.1 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	19.5
1	DNS (ROSS 85)	DNS (ROSS 85)	DNS (ROSS 85)
15	9.0 (ROSS 85)	5.2 (ROSS 85)	DNS (ROSS 85)
NOTE: DNS=DID NOT SPREAD			

1.0 TYPE: TERRA NOVA K-08 DST#3 CRUDE OIL.

2.0 API GRAVITY:

	WEATHERING (WT %)	
0	5.0	14.8
32.6 (PETRO-CAN 85)	30.5 (PETRO-CAN 85)	27.6 (PETRO-CAN 85)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	14.8
15	0.8620 (PETRO-CAN 85)	0.8729 (PETRO-CAN 85)	0.8891 (PETRO-CAN 85)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (VOL %)		
	0	5.0	14.8
25	18.7 (PETRO-CAN 85)	22.8 (PETRO-CAN 85)	201 (PETRO-CAN 85)
50	5.9 (PETRO-CAN 85)	8.2 (PETRO-CAN 85)	14.1 (PETRO-CAN 85)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C):

WEATHERING (WT %)	POUR POINT (°C)
0	12 (PETRO-CAN 85)
5.0	18 (PETRO-CAN 85)
14.8	24 (PETRO-CAN 85)

7.0 FLASH POINT ($^{\circ}\text{C}$):WEATHERING
(WT %)FLASH POINT
($^{\circ}\text{C}$)

0	<21 (PETRO-CAN 85)
5.0	<21 (PETRO-CAN 85)
14.8	52 (PETRO-CAN 85)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA ($^{\circ}\text{C}$):

VOLUME PERCENT	WEATHERING (WT %)		
	0	5.0	14.8
IBP	1	69	115
5	86	116	168
10	117	147	202
20	176	208	259
30	238	266	312
40	297	321	366
50	356	379	421
60	420	438	477
70	487	502	547

% off at
524 $^{\circ}\text{C}$

74.0

72.9

67.0

(ASTM D2887-MODIFIED) (PETRO-CAN 85)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	14.8
1	1.0 (ROSS 85)	1.0 (ROSS 85)	0.1 (ROSS 85)
15	1.0 (ROSS 85)	1.0 (ROSS 85)	1.0 (ROSS 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	14.8
1	1.0 (ROSS 85)	1.0 (ROSS 85)	1.0 (ROSS 85)
15	1.0 (ROSS 85)	1.0 (ROSS 85)	1.0 (ROSS 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	14.8
1	88.3 (ROSS 85)	87.1 (ROSS 85)	76.1 (ROSS 85)
15	90.1 (ROSS 85)	90.1 (ROSS 85)	90.0 (ROSS 85)

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY (g/m³):
in 35 ppt seawater at 22°C

WEATHERING (WT %)	SOLUBILITY (g/m ³)
0	23.1 (ROSS 85)
5.0	20.7 (ROSS 85)
14.8	3.4 (ROSS 85)

15.0 TOXICITY:

16.0 SULPHUR (WT %):

WEATHERING
(WT %)SULPHUR
(WT %)

0	0.68 (PETRO-CAN 85)
5.0	0.71 (PETRO-CAN 85)
14.8	0.76 (PETRO-CAN 85)

17.0 OTHERS:

17.1 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (WT %)		
	0	5.0	14.8
1	DNS (ROSS 85)	DNS (ROSS 85)	DNS (ROSS 85)
15	9.8 (ROSS 85)	8.0 (ROSS 85)	DNS (ROSS 85)

NOTE: DNS=DID NOT SPREAD

1.0 TYPE: TERRA NOVA K-08 DST#4 CRUDE OIL.

2.0 API GRAVITY:

	WEATHERING (WT %)	
	0	5.1
		14.2
32.5 (PETRO-CAN 85)	30.4 (PETRO-CAN 85)	27.5 (PETRO-CAN 85)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (WT %)	
	0	5.1
		14.2
15	0.8621 (PETRO-CAN 85)	0.8735 (PETRO-CAN 85)
		0.8895 (PETRO-CAN 85)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY:

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (WT %)	
	0	5.1
		14.2
25	18.2 (PETRO-CAN 85)	27.3 (PETRO-CAN 85)
		105 (PETRO-CAN 85)
50	5.9 (PETRO-CAN 85)	8.1 (PETRO-CAN 85)
		13.8 (PETRO-CAN 85)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C):

WEATHERING (WT %)	POUR POINT (°C)
0	12 (PETRO-CAN 85)
5.1	15 (PETRO-CAN 85)
14.2	21 (PETRO-CAN 85)

7.0 FLASH POINT ($^{\circ}\text{C}$):WEATHERING
(WT %)FLASH POINT
($^{\circ}\text{C}$)

-----	-----
0	<21 (PETRO-CAN 85)
5.1	<21 (PETRO-CAN 85)
14.2	60 (PETRO-CAN 85)
-----	-----

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA ($^{\circ}\text{C}$):

VOLUME PERCENT	WEATHERING (WT %)		
	0	5.1	14.2
-----	-----	-----	-----
IBP	3	76	130
5	90	120	175
10	119	151	210
20	177	210	267
30	234	264	320
40	290	316	377
50	345	370	434
60	405	427	494
70	467	484	

% off at

524 $^{\circ}\text{C}$ 77.0 75.6 64.2

(ASTM D2887-MODIFIED) (PETRO-CAN 85)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (WT %)		
	0	5.1	14.2
1	1.0 (ROSS 85)	1.0 (ROSS 85)	1.0 (ROSS 85)
15	1.0 (ROSS 85)	1.0 (ROSS 85)	1.0 (ROSS 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (WT %)		
	0	5.1	14.2
1	1.0 (ROSS 85)	1.0 (ROSS 85)	1.0 (ROSS 85)
15	1.0 (ROSS 85)	1.0 (ROSS 85)	1.0 (ROSS 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (WT %)		
	0	5.1	14.2
1	89.8 (ROSS 85)	86.7 (ROSS 85)	67.5 (ROSS 85)
15	87.4 (ROSS 85)	93.9 (ROSS 85)	89.3 (ROSS 85)

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY (g/m³):
in 35 ppt seawater at 22°C

WEATHERING (WT %)	SOLUBILITY (g/m ³)
0	18.7 (ROSS 85)
5.1	14.6 (ROSS 85)
14.2	2.2 (ROSS 85)

15.0 TOXICITY:

16.0 SULPHUR (WT %):

WEATHERING
(WT %)SULPHUR
(WT %)

0	0.67 (PETRO-CAN 85)
5.1	0.69 (PETRO-CAN 85)
14.2	0.74 (PETRO-CAN 85)

17.0 OTHERS:

17.1 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

		WEATHERING	
TEMP		(WT %)	
(°C)	0	5.1	14.2
0	DNS (ROSS 85)	DNS (ROSS 85)	DNS (ROSS 85)
15	8.6 (ROSS 85)	6.6 (ROSS 85)	DNS (ROSS 85)
NOTE: DNS=DID NOT SPREAD			

1.0 TYPE: TRADING BAY CRUDE OIL, OFFSHORE COOK INLET, ALASKA.

2.0 API GRAVITY: 31.0(COLEMAN 78)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.871(COLEMAN 78)

4.0 VISCOSITY (Saybolt Universal seconds):
@ 25 °C: 66(COLEMAN 78)
@ 37.8 °C: 53(COLEMAN 78)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): <-15(COLEMAN 78)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

CUT TEMPERATURE (°C)	VOLUME PERCENT
28	IBP
50	1.6
75	4.0
100	9.7
125	15.5
150	19.9
175	24.3
200	28.5
225	32.7
250	37.6
275	45.4

(COLEMAN 78)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.05(COLEMAN 78)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 4.3(COLEMAN 78)

17.2 NITROGEN (WT %): 0.149(COLEMAN 78)

17.3 COLOUR: BROWNISH BLACK(COLEMAN 78)

1.0 TYPE: TRADING BAY CRUDE OIL, COOK INLET, ALASKA.

2.0 API GRAVITY: 28.7(COLEMAN 78)

3.0 DENSITY (g/mL):
@ 15.6 °C: 0.883(COLEMAN 78)

4.0 VISCOSITY (Saybolt Universal seconds):
@ 25 °C: 129(COLEMAN 78)
@ 37.8 °C: 83(COLEMAN 78)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -1(COLEMAN 78)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

CUT TEMPERATURE (°C)	VOLUME PERCENT
24	IBP
75	4.1
100	8.0
125	12.0
150	16.0
175	20.0
200	24.0
225	28.8
250	34.3
275	39.1

(COLEMAN 78)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 0.15(COLEMAN 78)

17.0 OTHERS:

17.1 CARBON RESIDUE (WT %): 2.8(COLEMAN 78)

17.2 NITROGEN (WT %): 0.192(COLEMAN 78)

17.3 COLOUR: BROWNISH BLACK(COLEMAN 78)

1.0 TYPE: TRANSMOUNTAIN BLEND CRUDE OIL.

2.0 API GRAVITY (15/15°C): 33.8 (EETD 84)

3.0 DENSITY (g/mL):

For Fv < 28.5 % & T between 0 and 15 °C:

DEN = 0.866996 + 0.002108 Fv - 0.000758 T

where: DEN is density of oil at T and Fv (g/mL)

Fv is volume percent of oil weathered

T is oil temperature (°C)

TEMP (°C)	WEATHERING (VOL %)		
	0	18.8	28.5
0	0.865 (EETD 84)	0.9107 (EETD 85)	0.9250 (EETD 85)
15	0.855 (EETD 84)	0.8989 (EETD 85)	0.9127 (EETD 85)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.8	28.5
0	650 (EETD 85)	>10000 (EETD 85)	>>10000 (EETD 85)
15	10.5 (EETD 85)	142 (EETD 85)	577 (EETD 85)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.8	28.5
0	750 (EETD 85)		
15	12.3 (EETD 84)	158 (EETD 85)	632 (EETD 85)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.8	28.5
0	28.8 (EETD 85)	N/M (EETD 85)	N/M (EETD 85)
15	25.0 (EETD 84)	29.1 (EETD 85)	N/M (EETD 85)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.8	28.5
0	19.9 (EETD 85)	N/M (EETD 85)	N/M (EETD 85)
15	19.3 (EETD 84)	25.1 (EETD 85)	N/M (EETD 85)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.8	28.5
0	20.5 (EETD 85)	N/M (EETD 85)	N/M (EETD 85)
15	19.3 (EETD 84)	26.5 (EETD 85)	N/M (EETD 85)

6.0 POUR POINT (°C):

WEATHERING (VOL %)	POUR POINT (°C)
0	2 (EETD 85)
18.8	8 (EETD 85)
28.5	18 (EETD 85)

7.0 FLASH POINT (°C): -2.0 (C.C.) (EETD 85)

8.0 REID VAPOUR PRESSURE (kPa): 45.7 (EETD 84)

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE
IBP	113
5	144
10	174
15	203
20	234
25	265
30	295 (EETD 85)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (VOL %)		
	0	18.8	28.5
0	1.0 (EETD 85)	1.0 (EETD 85)	0 (EETD 85)
15	0.2 (EETD 84)	1.0 (EETD 85)	1.0 (EETD 85)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (VOL %)		
	0	18.8	28.5
0	1.0 (EETD 85)	1.0 (EETD 85)	0 (EETD 85)
15	0.1 (EETD 84)	1.0 (EETD 85)	1.0 (EETD 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.8	28.5
0	90.1 (EETD 85)	75.4 (EETD 85)	N/A (EETD 85)
15	N/A (EETD 84)	89.0 (EETD 85)	87.0 (EETD 85)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 6488 \theta \exp(6.3 - 3924.3/TK)/TK)}{(6488/TK)}$$

where: Fv is fraction of oil weathered by volume
 ln is natural log
 θ is evaporation exposure
 exp is exponential base e
 TK is environmental temperature
 (Kelvin, K = °C + 273)
 (EETD 84)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
 OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	18.8	28.5
0	40 (EETD 85)	0 (EETD 85)	0 (EETD 85)
15	84 (EETD 85)	79 (EETD 85)	83 (EETD 85)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	18.8	28.5
0	0 (EETD 85)	0 (EETD 85)	0 (EETD 85)
15	1 (EETD 84)	0 (EETD 85)	0 (EETD 85)

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

SATURATES 81.0
 AROMATICS 13.6
 POLARS 1.9
 ASPHALTENES 3.5 (EETD 86)

14.0 AQUEOUS SOLUBILITY (mg/L):

in fresh water @ 22°C: 15.5 (SUNTIO 86)
 in fresh water: 7.9 (MACLEAN 88)
 in seawater: 5.56 (MACLEAN 88)

15.0 TOXICITY (mg/L):

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO DAPHNIA MAGNA:

48 hour EC50: 1.1(MACLEAN 88)

2.2(BOBRA 88)

48 hour LC50: 4.27(MACLEAN 88)

8.4(BOBRA 88)

ACUTE TOXICITY OF WATER SOLUBLE FRACTION TO ARTEMIA SPP.:

24 hour EC50: 3.6 (MACLEAN 88)

8.0(BOBRA 88)

24 hour LC50: >5.56(MACLEAN 88)

>12.4(BOBRA 88)

NOTE: RESULTS FROM (MACLEAN 88) OBTAINED BY FLUORESCENCE
SPECTROSCOPY.RESULTS FROM (BOBRA 88) OBTAINED BY PURGE-AND-TRAP
GC ANALYSIS.

16.0 SULPHUR:

17.0 OTHERS:

- 1.0 TYPE: UKALERK 2C-50 CRUDE OIL.
- 2.0 API GRAVITY: 45.7(DOME 84)
- 3.0 DENSITY (g/mL):
@ 21 °C: 0.7978(DOME 84)
- 4.0 VISCOSITY:
- 5.0 INTERFACIAL TENSIONS:
- 6.0 POUR POINT (°C): 1.7(DOME 84)
- 7.0 FLASH POINT:
- 8.0 VAPOUR PRESSURE:
- 9.0 DISTILLATION DATA:
- 10.0 EMULSION FORMATION TENDENCY & STABILITY:
- 11.0 WEATHERING:
- 12.0 DISPERSIBILITY:
- 13.0 HYDROCARBON GROUP ANALYSIS:
- 14.0 AQUEOUS SOLUBILITY:
- 15.0 TOXICITY:
- 16.0 SULPHUR:
- 17.0 OTHERS:

1.0 TYPE: UVILUK P-66 CRUDE OIL. DOME, TEXACO ET AL., 1983.

2.0 API GRAVITY (15/15°C): 24.9(EETD 85)

3.0 DENSITY (g/mL):

For fresh oil and T between 0 and 25 °C:

$$\text{DEN} = 0.91542 - 0.000727 T$$

where: DEN is density of oil at T

T is oil temperature (°C,

TEMP (°C)	WEATHERING (%)	
	0	
0	0.9155(EETD 85)	
15	0.9040(EETD 85)	
20	0.9012(EETD 85)	
25	0.8972(EETD 85)	

4.0 VISCOSITY:

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)	
	0	
0		
15	28.6(EETD 85)	

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (%)	
	0	
0		
15	8.8(EETD 85)	

5.3 OIL-WATER (mN/m or dynes/cm):

WEATHERING
(%)

TEMP
(°C)

0

0

15

21.4 (EETD 85)

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME
PERCENT

LIQUID
TEMPERATURE

VAPOUR
TEMPERATURE

IBP

185

69

5

209

108

10

233

114

15

257

148

20

281

162

25

305

171

(EETD 85)

(EETD 85)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

WEATHERING
(%)

TEMP
(°C)

0

0

15

0 (EETD 85)

10.2 EMULSION STABILITY:

WEATHERING
(%)

TEMP
(°C)

0

0

15

0 (EETD 85)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):
WEATHERING

TEMP (°C)	(%)
0	
15	N/A (EETD 85)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 4906 \theta \exp(6.3 - 4722/TK)/TK)}{(4906/TK)}$$

where: Fv is fraction of oil weathered by volume
 ln is natural log
 θ is evaporation exposure
 exp is exponential base e
 TK is environmental temperature
 (Kelvin, K = °C + 273)
 (EETD 85)

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

1.0 TYPE: UVILUK CRUDE OIL.

2.0 API GRAVITY (15/15°C): 29.4 (EETD 86)

3.0 DENSITY (g/mL):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.7	20.0
0	0.8899 (EETD 86)	0.9090 (EETD 86)	0.9244 (EETD 86)
15	0.8787 (EETD 86)	0.8978 (EETD 86)	0.9152 (EETD 86)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.7	20.0
0	32.2 (EETD 86)	88.6 (EETD 86)	266.3 (EETD 86)
15	13.8 (EETD 86)	27.5 (EETD 86)	67.1 (EETD 86)

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.7	20.0
0	28.6 (EETD 86)		428.7 (EETD 86)
15	15.7 (EETD 86)		70.9 (EETD 86)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.7	20.0
0	28.7 (EETD 86)	32.7 (EETD 86)	N/M (EETD 86)
15	26.7 (EETD 86)	28.0 (EETD 86)	29.8 (EETD 86)

5.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.7	20.0
0	23.5 (EETD 86)	18.7 (EETD 86)	N/M (EETD 86)
15	12.2 (EETD 86)	13.8 (EETD 86)	13.9 (EETD 86)

5.3 OIL-WATER (mN/m or dynes/cm):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.7	20.0
0	25.2 (EETD 86)	24.8 (EETD 86)	N/M (EETD 86)
15	24.3 (EETD 86)	23.2 (EETD 86)	22.8 (EETD 86)

6.0 POUR POINT (°C):

WEATHERING (VOL %)	POUR POINT (°C)
0	-12 (EETD 86)
9.7	- 3 (EETD 86)
20.0	3 (EETD 86)

7.0 FLASH POINT (°C): -9 (C.C) (EETD 86)

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA (°C):

VOLUME PERCENT	LIQUID TEMPERATURE	VAPOUR TEMPERATURE
IBP	123	50
5	163	102
10	184	118
15	206	134
20	233	157
25	261	184
30	287	212
35	312	237
40	336	259
45	362	277
50	392	299
55	414	323
	(EETD 86)	(EETD 86)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

10.1 EMULSION FORMATION TENDENCY:

TEMP (°C)	WEATHERING (VOL %)		
	0	9.7	20.0
0	1.0(EETD 86)	1.0(EETD 86)	1.0(EETD 86)
15	0.08(EETD 86)	1.0(EETD 86)	1.0(EETD 86)

10.2 EMULSION STABILITY:

TEMP (°C)	WEATHERING (VOL %)		
	0	9.7	20.0
0	0.31(EETD 86)	1.0(EETD 86)	1.0(EETD 86)
15	0(EETD 86)	0(EETD 86)	0.31(EETD 86)

10.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.7	20.0
0	95.8(EETD 86)	90.0(EETD 86)	69.7(EETD 86)
15	N/M(EETD 86)	N/M(EETD 86)	N/M(EETD 86)

11.0 WEATHERING:

$$F_v = \frac{\ln(1 + 5209 \theta \exp(6.3 - 4194/TK)/TK)}{(5209/TK)}$$

where: F_v is fraction of oil weathered by volume
 $\ln$ is natural log
 θ is evaporation exposure
 $\exp$ is exponential base e
 TK is environmental temperature
 (Kelvin, $K = ^\circ C + 273$)
 (EETD 86)

12.0 DISPERSIBILITY:

12.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
 OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (°C)	WEATHERING (VOL %)		
	0	9.7	20.0
0	54.5 (EETD 86)	61.8 (EETD 86)	64.0 (EETD 86)
15	54.3 (EETD 86)	58.4 (EETD 86)	60.9 (EETD 86)

12.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (°C)	WEATHERING (VOL %)		
	0	9.7	20.0
0	0 (EETD 86)	0 (EETD 86)	0 (EETD 86)
15	7.6 (EETD 86)	2.8 (EETD 86)	0 (EETD 86)

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

WEATHERING
(VOL %)SULPHUR CONTENT
(WT %)

-----	-----
0	0.24 (EETD 86)
9.7	0.17 (EETD 86)
20.0	0.24 (EETD 86)
-----	-----

17.0 OTHERS:

1.0 TYPE: WABASCA BITUMEN.

METHOD OF PRODUCTION IS COLD BAILING & CENTRIFUGATION.

2.0 API GRAVITY: 11.0 to 18.1 (ARC 87)

3.0 DENSITY (g/mL): 0.946 to 0.993 (ARC 87)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

WEATHERING

TEMP
(°C)

(%)

0

25

420 to 27,100 (ARC 87)

4.2 KINEMATIC VISCOSITY:

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT:

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS (WT %):

ASPHALTENES 10.3 to 15.2 (ARC 87)

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (WT %): 3.93 to 5.62 (ARC 87)

17.0 OTHERS:

17.1 CARBON (WT %): 81.22 to 83.89 (ARC 87)

17.2 HYDROGEN (WT %): 10.84 to 11.30 (ARC 87)

17.3 NITROGEN (WT %): 0.30 to 1.23 (ARC 87)

17.4 OXYGEN (WT %): 0.74 to 1.25 (ARC 87)

17.5 METALS (PPM WT):

VANADIUM 128.8 to 183.6 (ARC 87)

NICKEL 46.8 to 87.2 (ARC 87)

17.6 RAMSBOTTOM CARBON RESIDUE (WT %): 7.2 to 9.2 (ARC 87)

17.7 ASH (WT %): 0.09 to 0.50 (ARC 87)

17.8 ACID NUMBER: 0.49 to 1.87 (ARC 87)

1.0 TYPE: WAINWRIGHT-KINSELLA CRUDE OIL, ALBERTA.

2.0 API GRAVITY: 23.1(AALUND 83A)

3.0 DENSITY (g/mL):
@ 21 °C: 0.9145(AALUND 83A)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):

4.2 KINEMATIC VISCOSITY (mm²/sec or cSt):
@ 40 °C: 32.50(AALUND 83A)

5.0 INTERFACIAL TENSIONS:

6.0 POUR POINT (°C): -39.0(AALUND 83A)

7.0 FLASH POINT:

8.0 REID VAPOUR PRESSURE (kPa): 30.3(AALUND 83A)

9.0 DISTILLATION DATA:

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR (PPM): 15,800(AALUND 83A)

17.0 OTHERS:

17.1 CON. CARBON (WT %): 6.70(AALUND 83A)

17.2 METALS (PPM): NICKEL: 40.30(AALUND 83A)
VANADIUM: 79.90(AALUND 83A)

17.3 YIELD ON CRUDE:

	<u>RANGE, °C</u>	<u>VOL %</u>
NAPHTHA	C ₅ - 190	19.0
KEROSINE	190 - 277	12.0
DISTILLATE	277 - 343	11.0
GAS OIL	343 - 565	26.0
RESIDUE	565 +	32.0

(AALUND 83A)

1.0 TYPE: WEYBURN-MIDALE CRUDE OIL.

2.0 API GRAVITY:

3.0 DENSITY (g/mL):
@ ROOM TEMP: 0.89 (TWARDUS 80)

4.0 VISCOSITY:

4.1 DYNAMIC VISCOSITY (mPa.s or cp):
WEATHERING
(%)

TEMP (°C)	0
0	88 (TWARDUS 80)
10	29 (TWARDUS 80)
20	18 (TWARDUS 80)

5.0 INTERFACIAL TENSIONS:

5.1 AIR-OIL (mN/m or dynes/cm):
@ ROOM TEMP: 24.1 (TWARDUS 80)

5.2 OIL-WATER (mN/m or dynes/cm):
@ ROOM TEMP: 29.7 (TWARDUS 80)

6.0 POUR POINT (°C): -28 (TWARDUS 80)

7.0 FLASH POINT:

8.0 VAPOUR PRESSURE:

9.0 DISTILLATION DATA:

VOLUME PERCENT	TEMP (°C)
0	45
10	90
20	130
30	190
40	230
50	265
60	275
70	335
80	385 (TWARDUS 80)

10.0 EMULSION FORMATION TENDENCY & STABILITY:

11.0 WEATHERING:

12.0 DISPERSIBILITY:

13.0 HYDROCARBON GROUP ANALYSIS:

14.0 AQUEOUS SOLUBILITY:

15.0 TOXICITY:

16.0 SULPHUR:

17.0 OTHERS:

17.1 FIRE POINT ($^{\circ}\text{C}$): <14 (TWARDUS 80)

17.2 IN-SITU COMBUSTION OF FRESH OIL:

EASILY IGNITED, 7.4 VOL % RESIDUE (TWARDUS 80)

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